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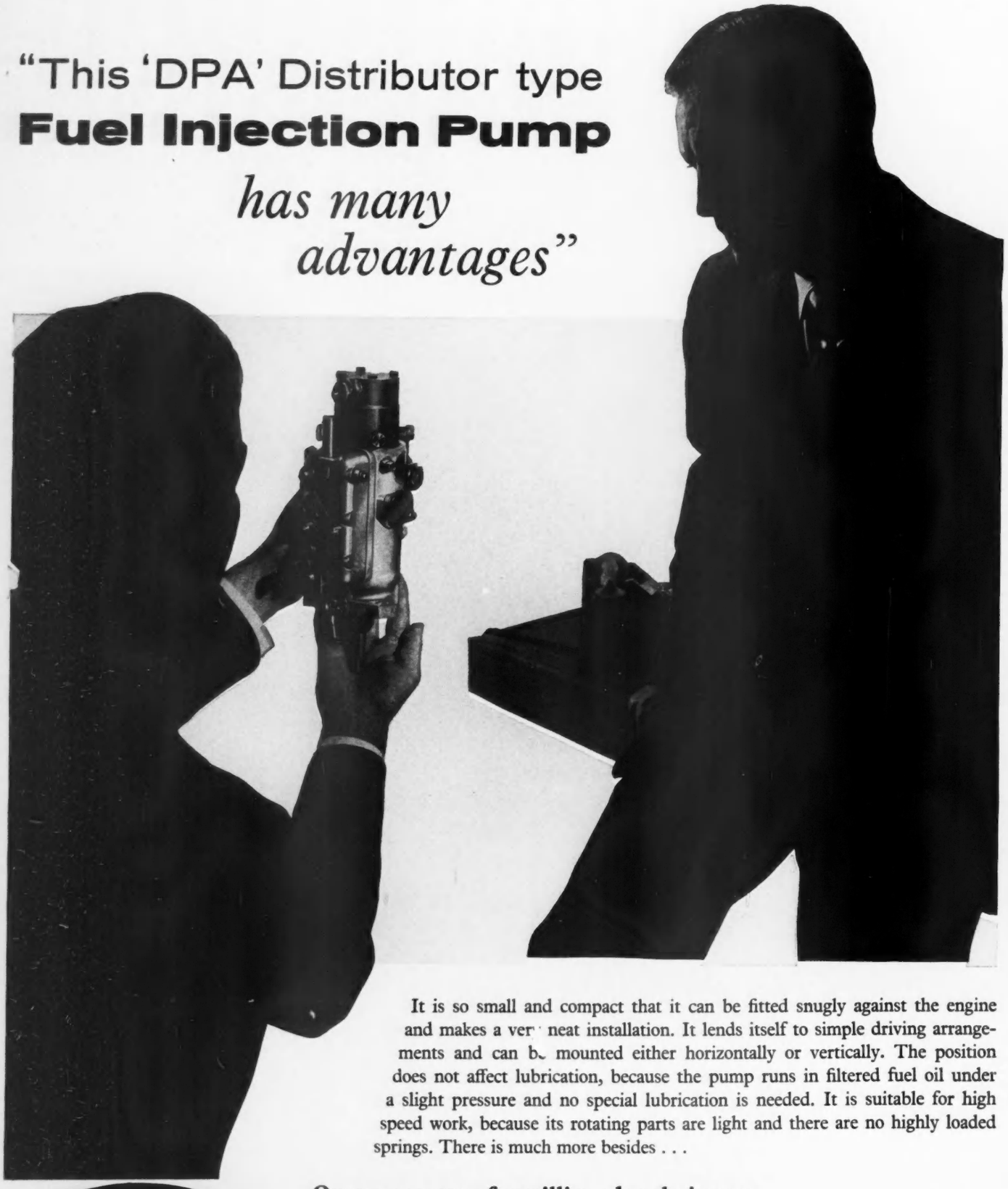

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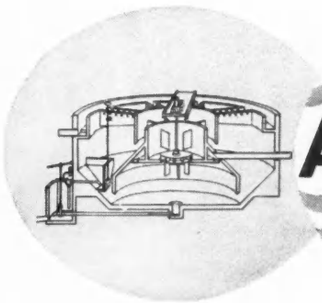

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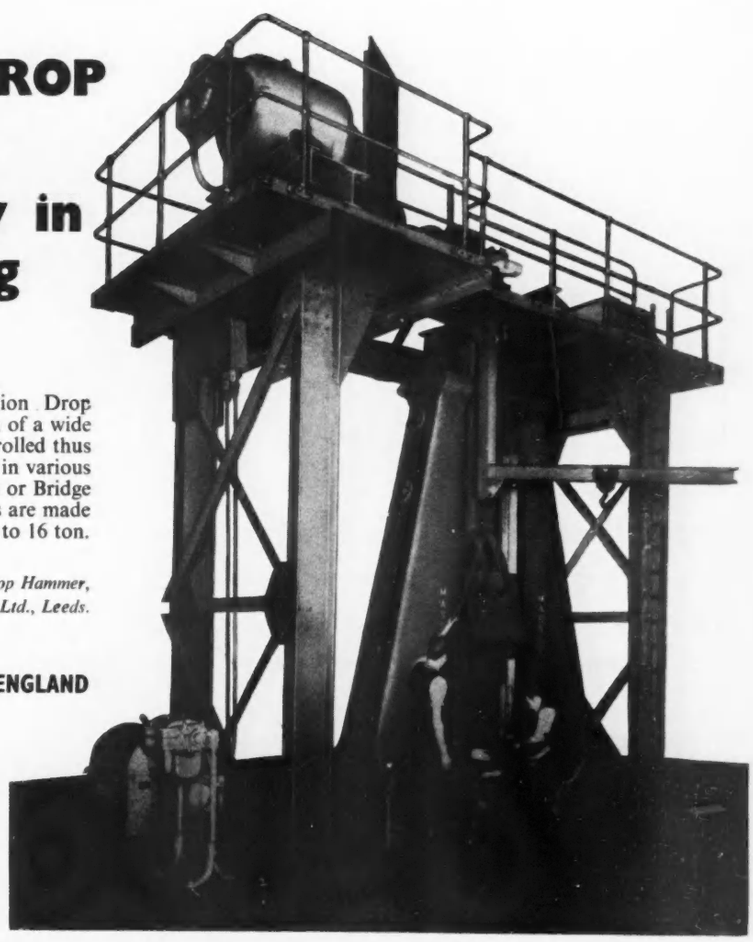

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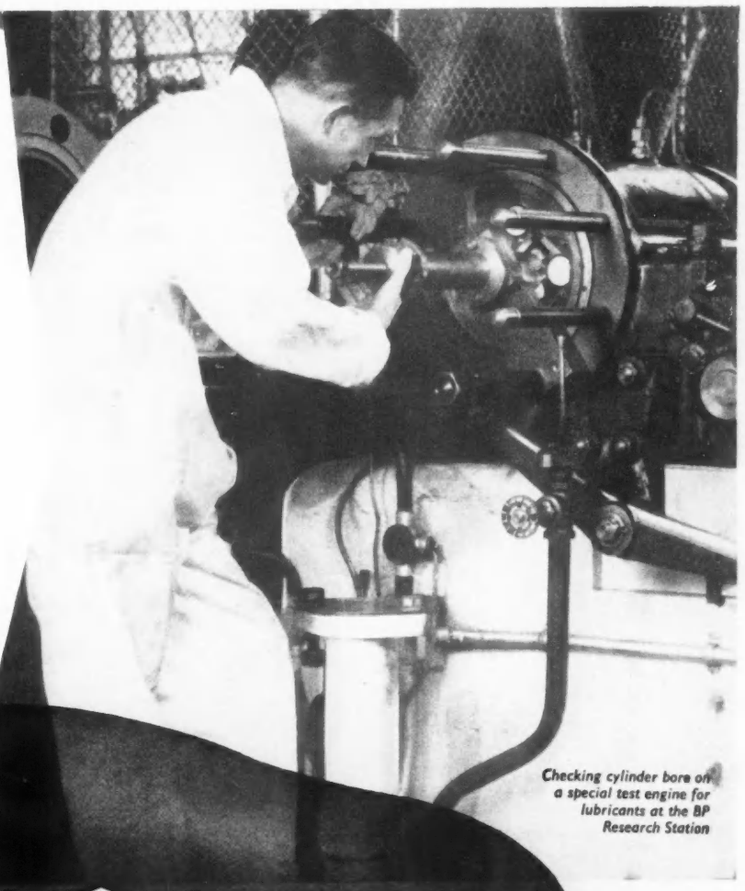

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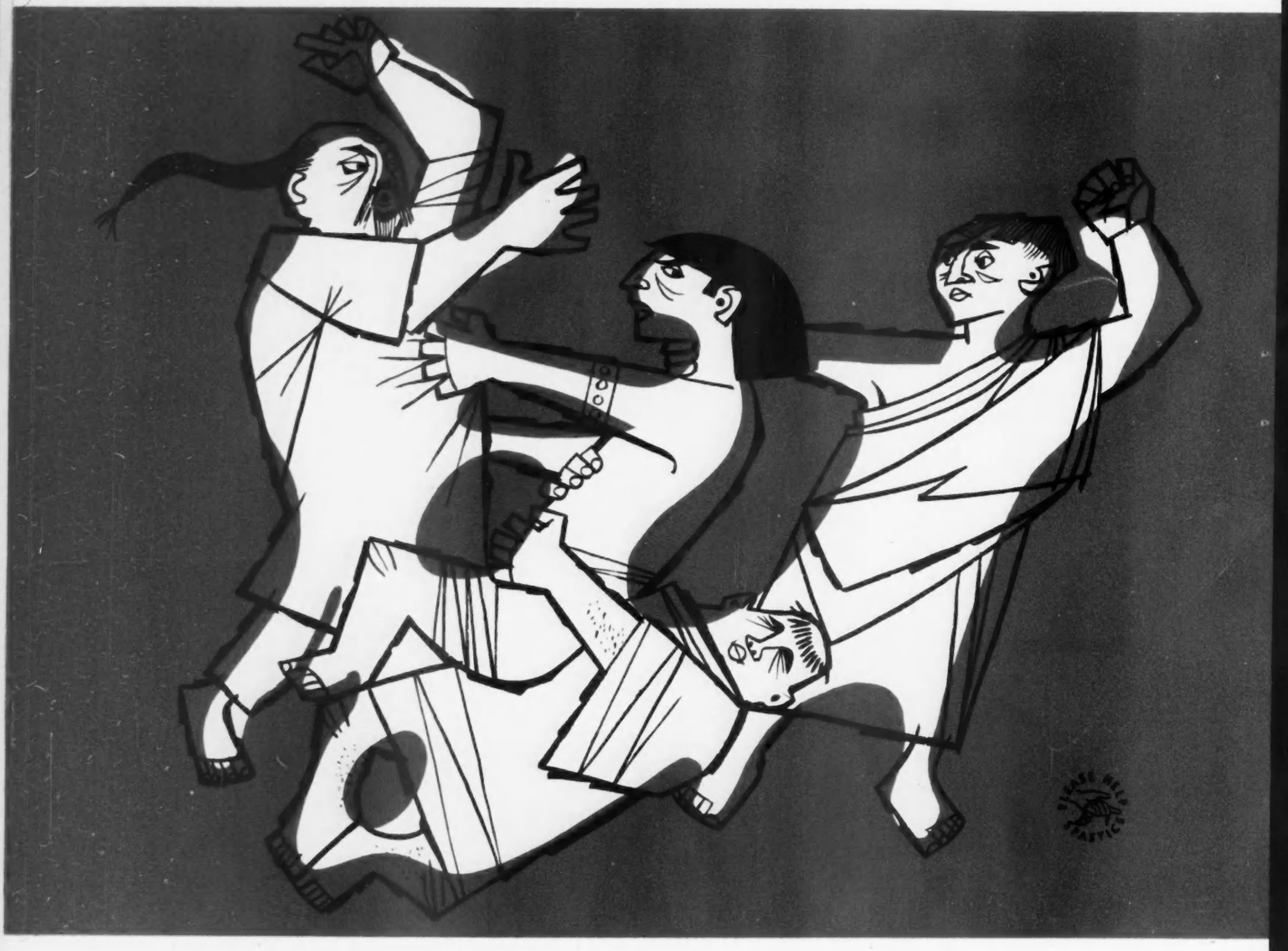

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First-stage assembly of a cream separator. The operator is fitting internal helical gearing and ball races into the housing. (*Nurnberg photograph for* ENGINEERING.)

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2. Tenders should be made in triplicate in accordance with the Condition of Tender, Specification, etc., which may be obtained at the Office of the Chief Engineer, Construction and Maintenance (Water-Works), Public Works Department, Ratmalana, Ceylon, or other issuing officers noted hereunder up to noon on Monday, 21st March, 1960, on payment of a tender deposit of Rs. 1,000/- where the tender is issued in Ceylon and on payment of a tender deposit of £100 and a tender fee of £10 where the tender is issued elsewhere. Sealed tenders may be sent either under registered cover addressed to the Chairman, Tender Board, Ministry of Works, Transworks House, Colombo, Ceylon, or handed personally to him. The sealed tenders should state on the cover particulars of service, and the name and address of the tenderer.

3. When applying for tender forms tenderers should produce evidence that they have done similar work elsewhere and that they have employees on their staff fully qualified to undertake the proposed work. They should also produce evidence that they have Local Agents in Ceylon. They should further be prepared to furnish names and addresses of their proposed sureties.

4. Tenderers should keep their tenders open for a period of 60 days from the closing date of this tender to enable the consideration of the tenders received.

5. Tender forms and connected documents will be issued by:—

(*a*) In Ceylon by the Chief Engineer, Construction and Maintenance (Water-Works), Public Works Department,, Ratmalana, Ceylon.

(*b*) In all overseas countries, by the Consulting Engineers, Messrs. Eau et Assainissement, 6 Rue Piccini, Paris 16, France.

Prospective overseas tenderers, if they so wish, may also obtain the tender forms and connected documents through the diplomatic representatives of the Ceylon Government mentioned below, who will also keep a set each of specimen tender forms and documents for examination only.

1. Office of H.E. the High Commissioner for Ceylon in the United Kingdom.
2. Office of H.E. the Ambassador Extraordinary and Minister Plenipotentiary for Ceylon in the U.S.A.
3. Office of H.E. the Ambassador Extraordinary and Minister Plenipotentiary for Ceylon in Germany.
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6. Office of the High Commissioner for Ceylon in Australia and New Zealand.
7. Office of the High Commissioner for Ceylon in Canada.
8. Office of H.E. the Ambassador Extraordinary and Minister Plenipotentiary for Ceylon in China.
9. Office of H.E. the Ambassador Extraordinary and Minister Plenipotentiary for Ceylon in Japan.
10. Office of H.E. the Ambassador Extraordinary and Minister Plenipotentiary for Ceylon in U.S.S.R.

6. The Tender deposit should be made at the P.W.D. HEAD OFFICE, COLOMBO, CEYLON, by local tenderers. Overseas tenderers should pay the tender deposit and tender fee to Messrs. Eau et Assainissement, 6 Rue Piccini, Paris 16, France, or to any one of the Diplomatic Representatives of the Ceylon Government in the countries mentioned above.

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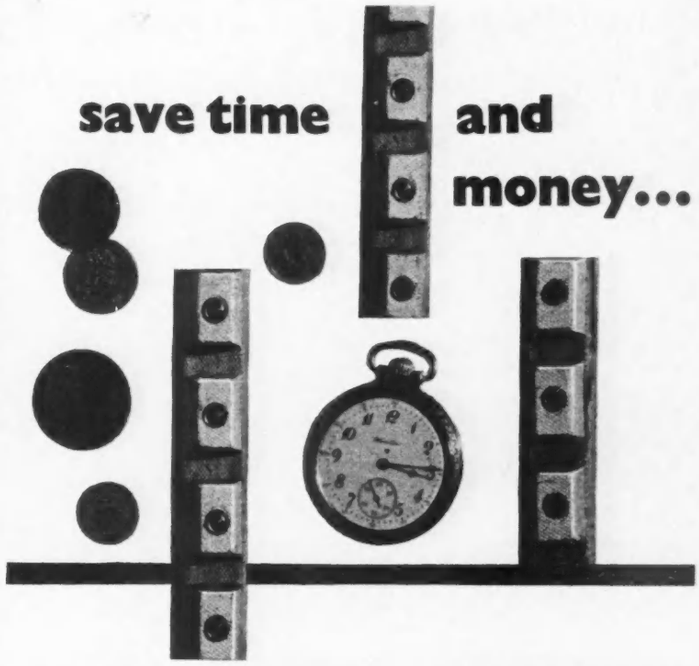

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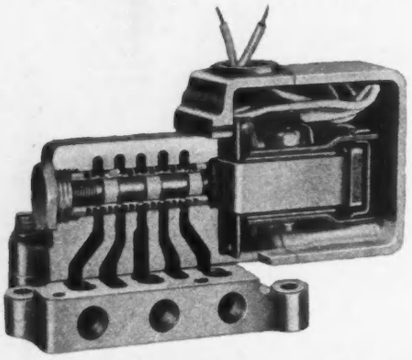

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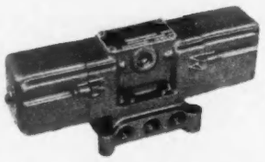

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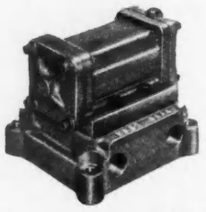

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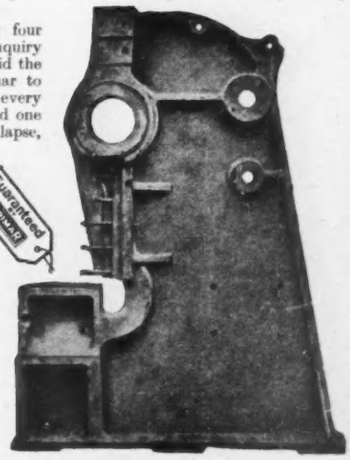

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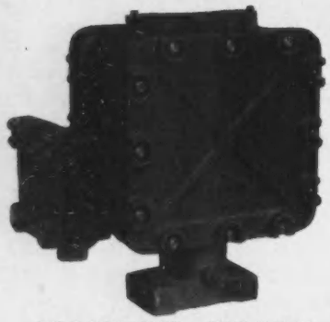

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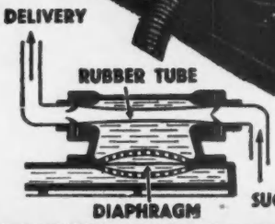

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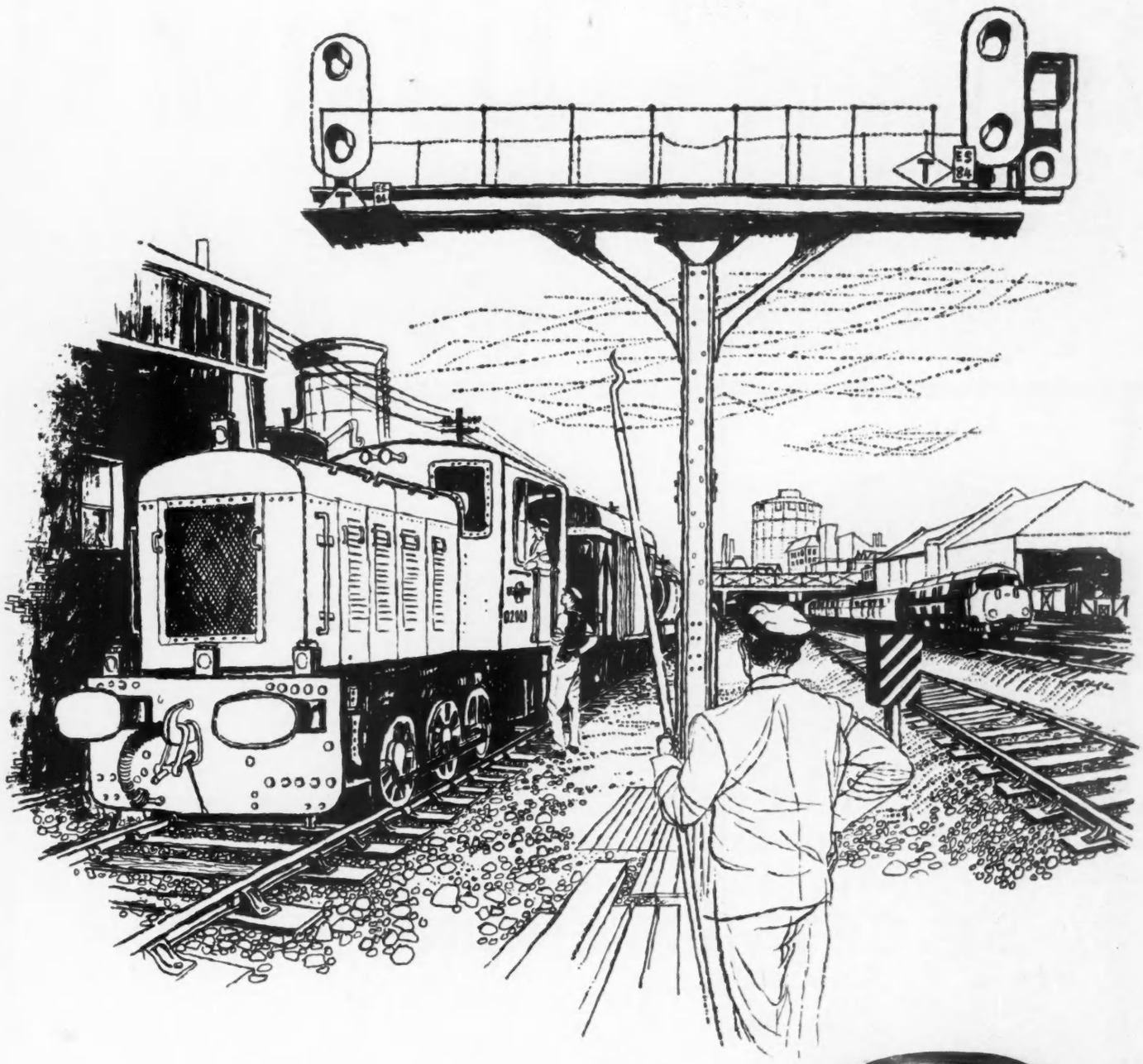

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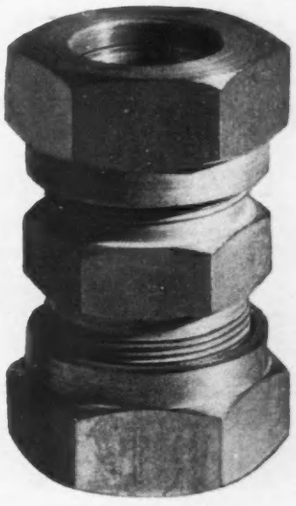

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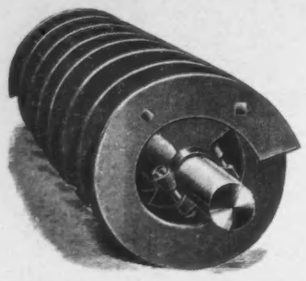

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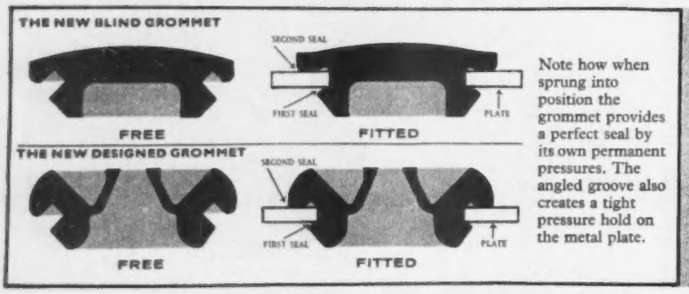
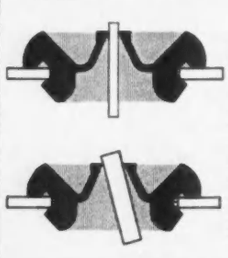


Note how when sprung into position the grommet provides a perfect seal by its own permanent pressures. The angled groove also creates a tight pressure hold on the metal plate.



A useful feature of this cable grommet is that by reason of the designed taper of the cable entry and the flexibility of the web, a considerable angle of cable entry and a variety of cable size, are possible. This avoids necessity for special grommets with angled bores.

In the conventional grommet, only one thickness of plate and only one size of cable can be accommodated. No effective seal is afforded by the parallel groove.

This new development in grommets is now being produced in a range of sizes
These new grommets will solve your sealing problem

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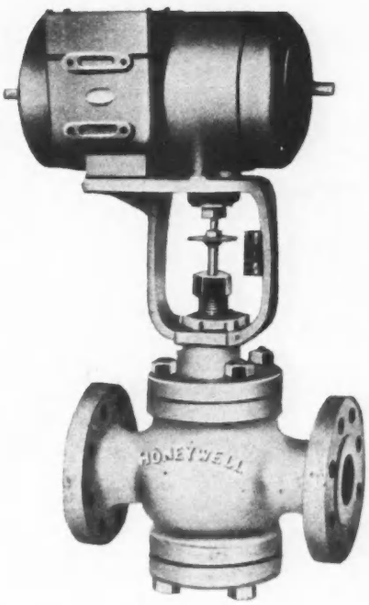

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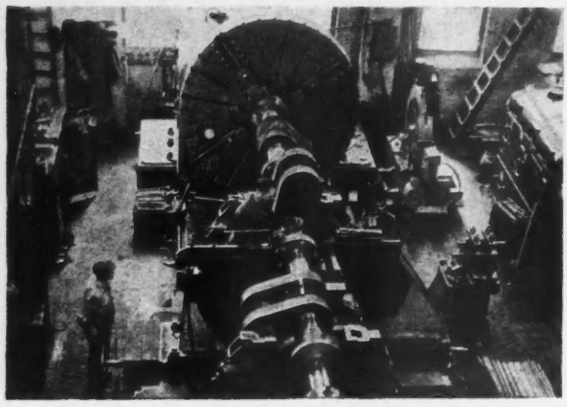

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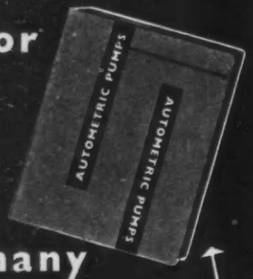

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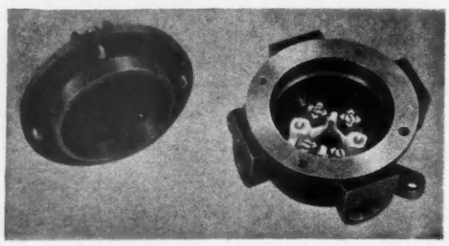

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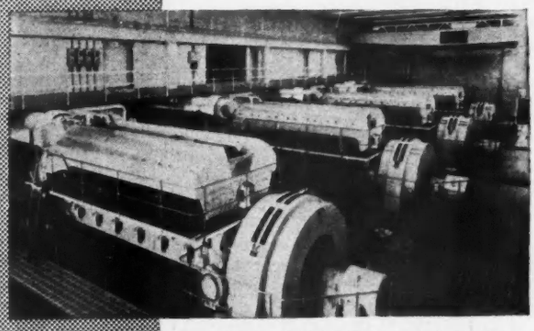

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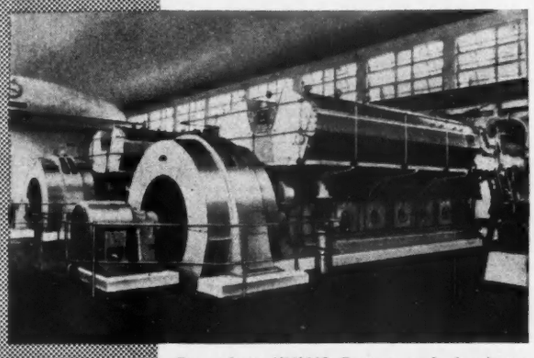

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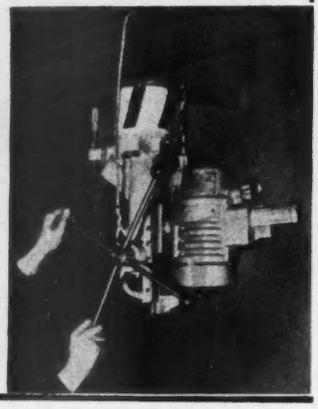

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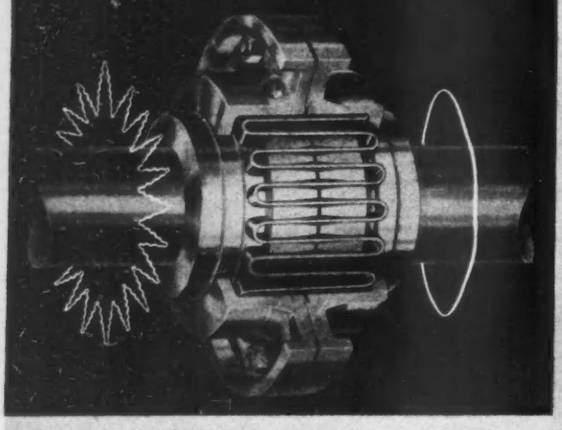

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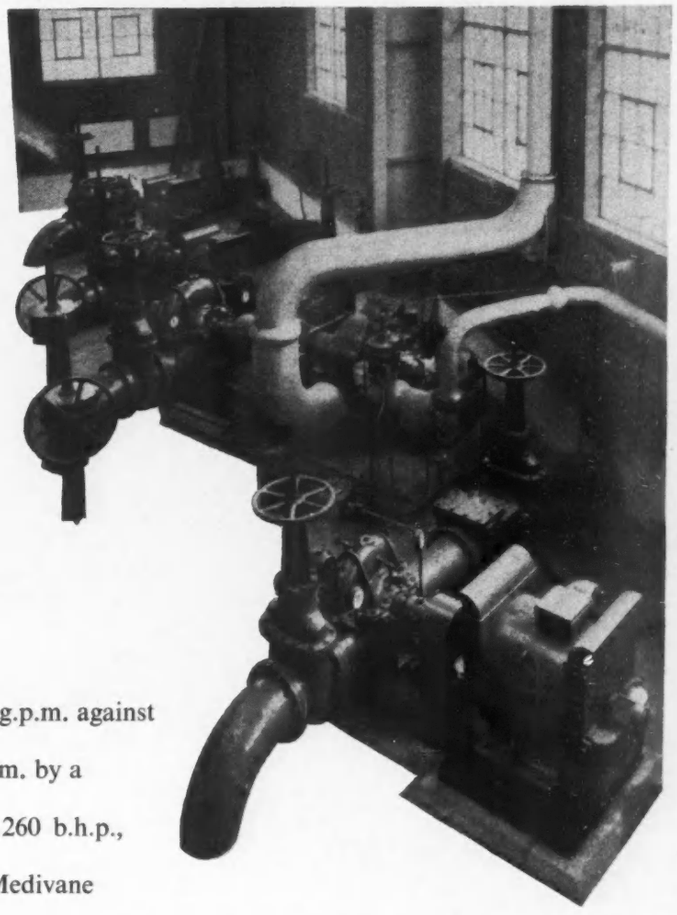

Mather & Platt pumps and motors on furnace cooling duty in the pump house of a large steel works. In the foreground is a 12″/15″ Medivane delivering 4,500 g.p.m. against a 140 ft. head and driven at 1,470 r.p.m. by a drip-proof squirrel-cage motor rated at 260 b.h.p., 2,750 volts; next to this is a 16″/20″ Medivane driven by steam turbine, and in the background are two 17″/20″ Lonovanes driven by drip-proof squirrel-cage induction motors.

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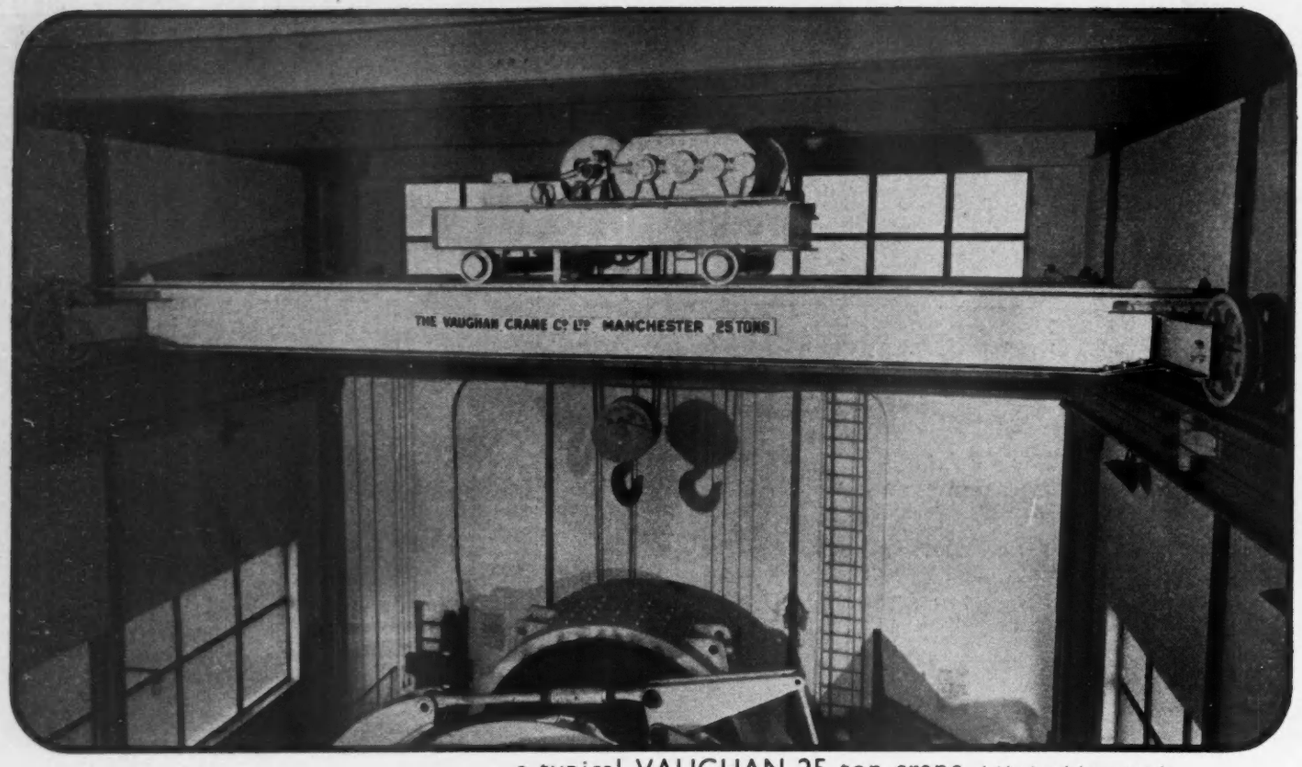

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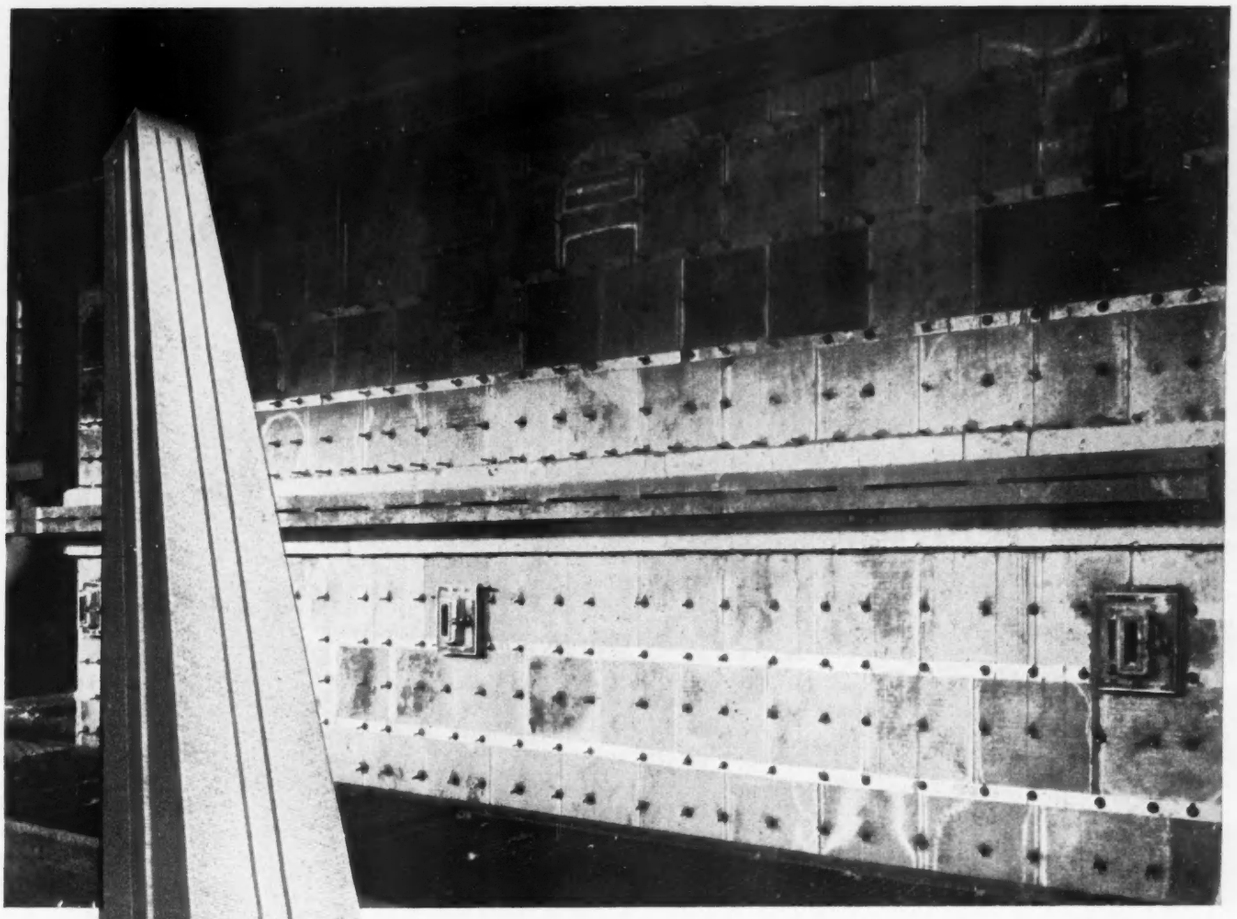

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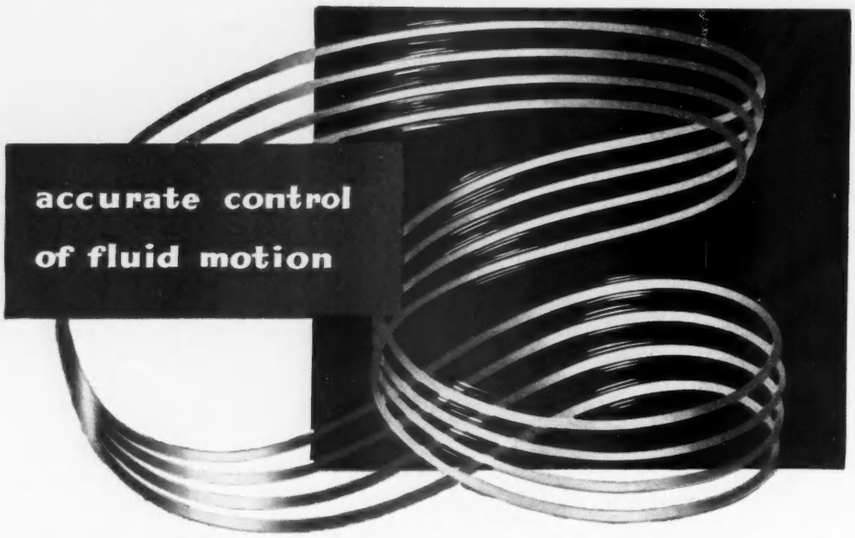

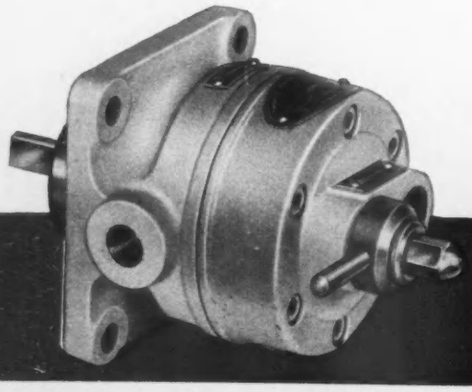

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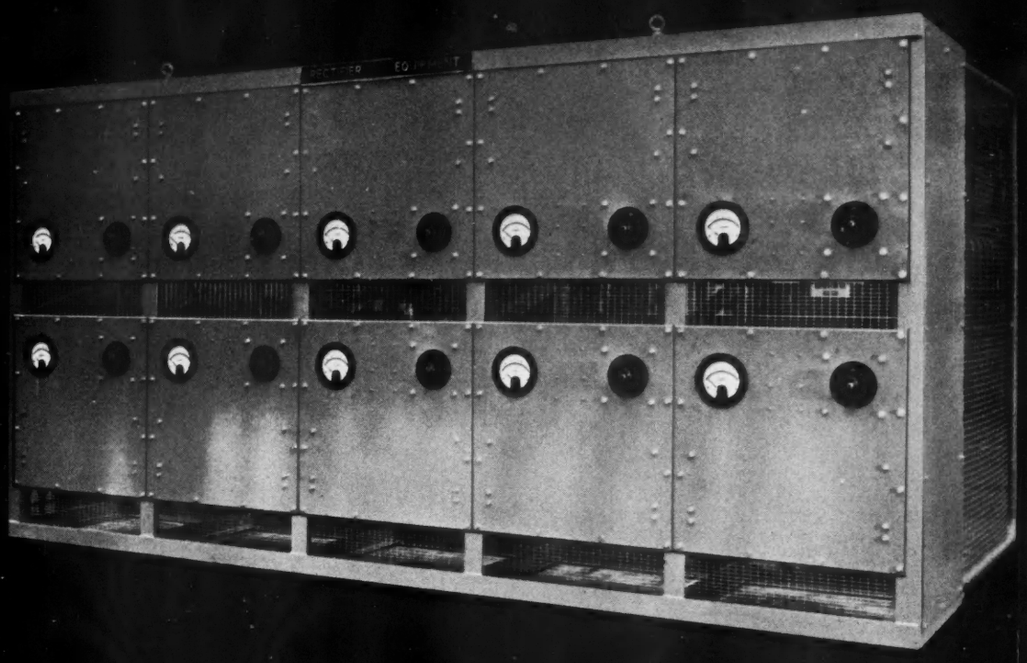

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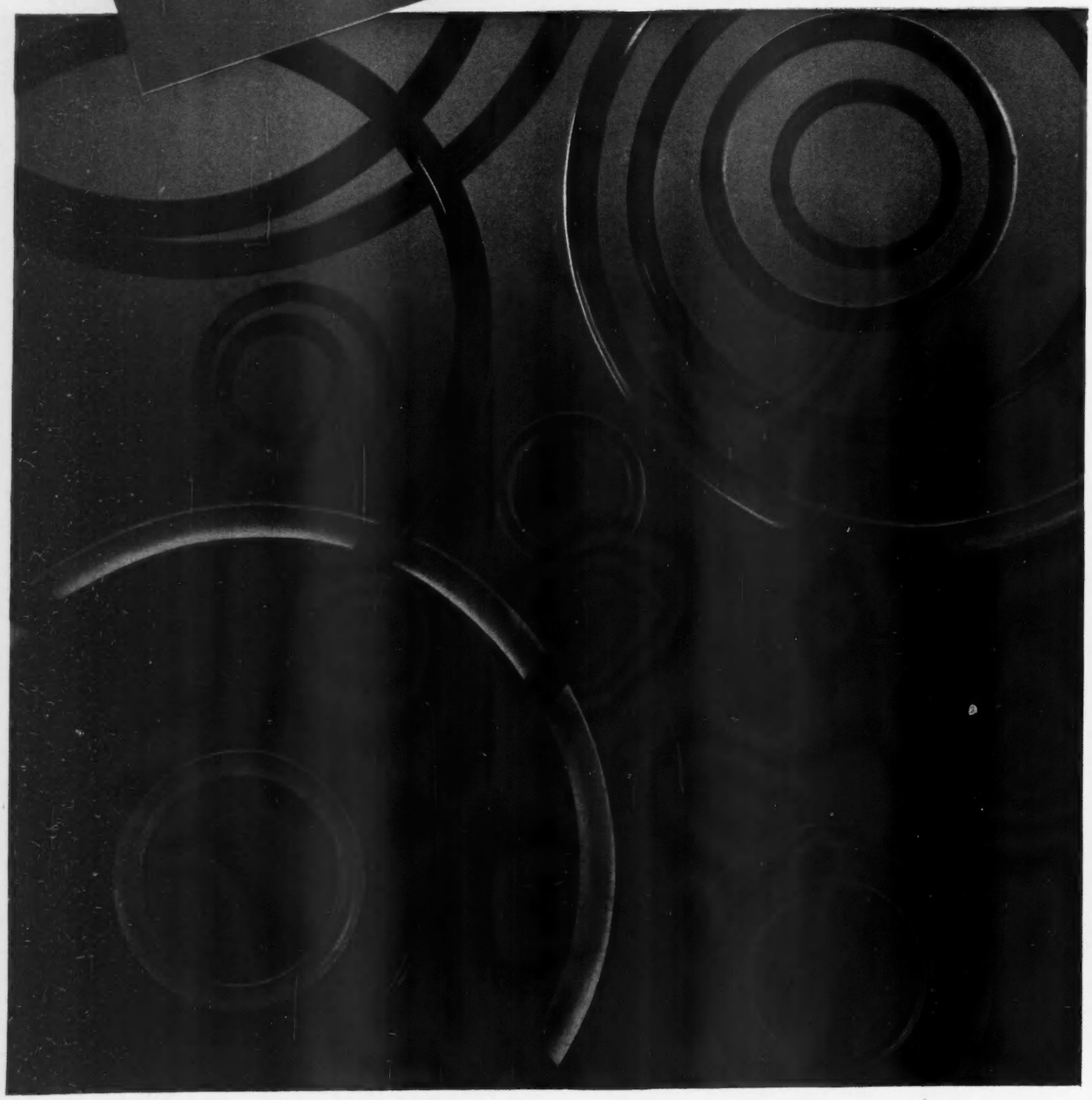

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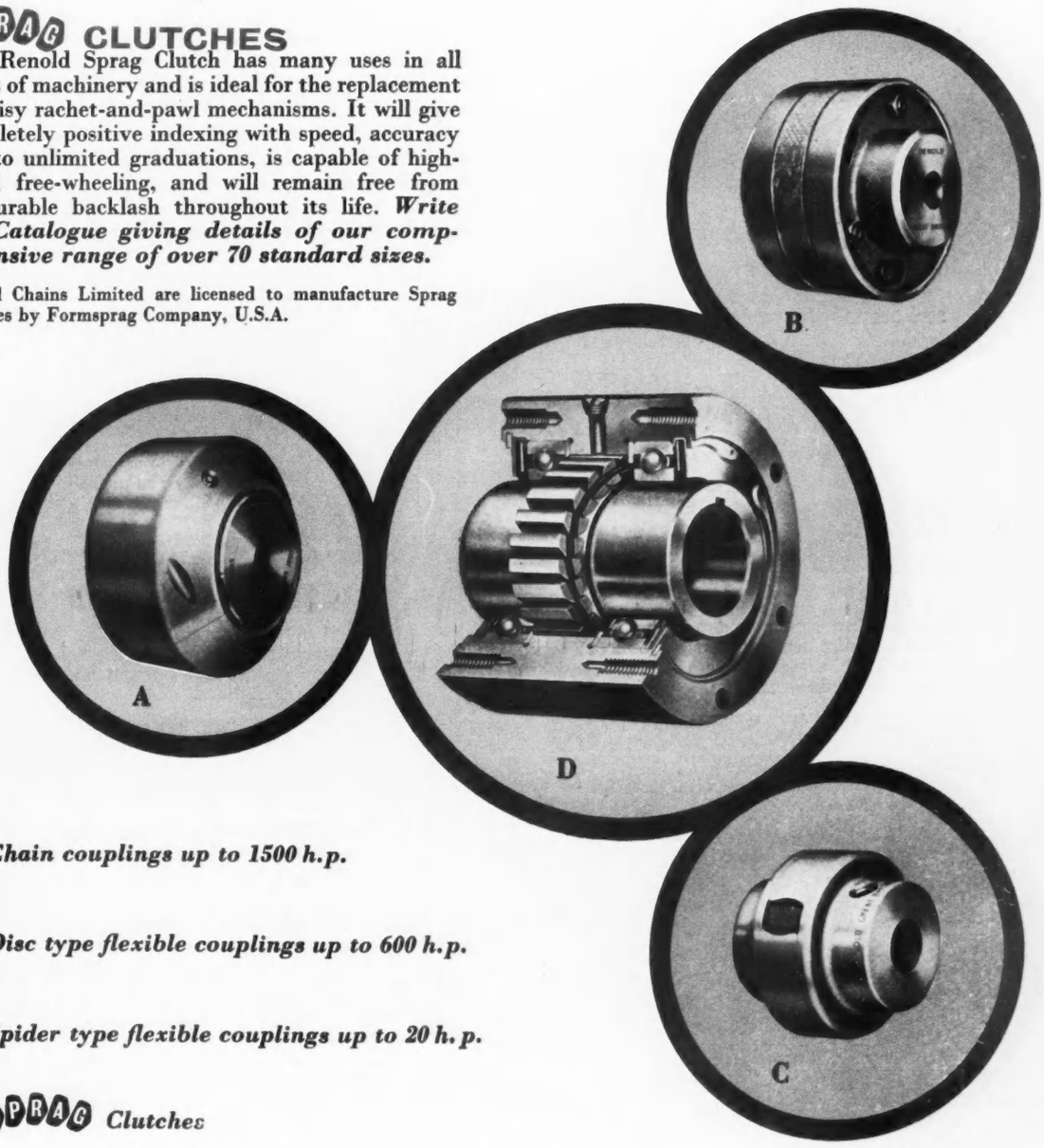

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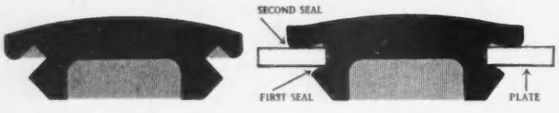
PAT. APP. No. 5255/59

is the solution to many an engineering problem

This grommet provides a thoroughly efficient seal. Around the panel hole the first seal is effected, while a good, tight *second* seal around top periphery is set up by tension.

In the grommets designed for cable entry the internal seal is applied within the conical section. All grommets can be fitted to various panel thicknesses—thus reducing the range.

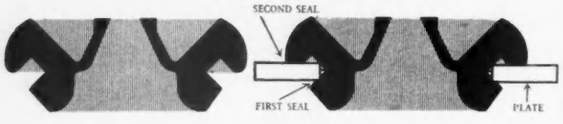
THE NEW BLIND GROMMET



FREE **FITTED**

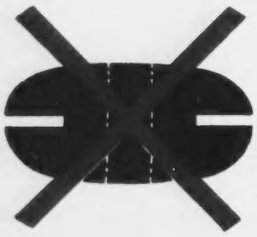
Note how when sprung into position the grommet provides a perfect double seal by its own permanent pressures. The angled groove also creates a tight pressure hold on the metal plate.

THE NEW DESIGNED GROMMET

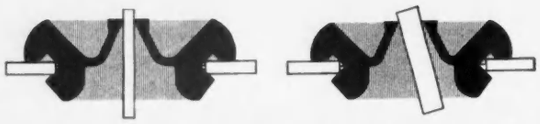


FREE **FITTED**

In the cable grommet variety the same double pressure seal is created, allied to tight seal on various diameters of cable. This new grommet gives sound sealing at *all* vital points.



In the conventional grommet, only one thickness of plate and only one size of cable can be accommodated. No effective seal is afforded by the parallel groove.



A useful feature of this cable grommet is that by reason of the designed taper of the cable entry and the flexibility of the web, a considerable angle of cable entry and a variety of cable size are possible. This avoids necessity for special grommets with angled bores.

ENQUIRE
for Catalogue section and detailed particulars

Being produced in a range of sizes

THESE GROMMETS WILL SOLVE YOUR SEALING PROBLEMS

R.B.102

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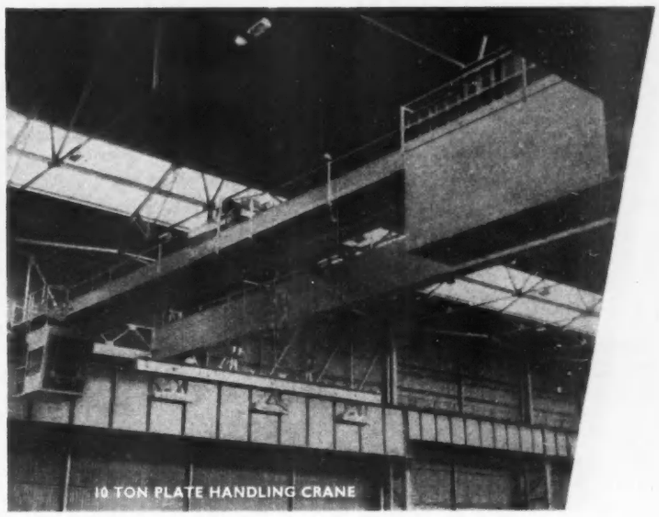
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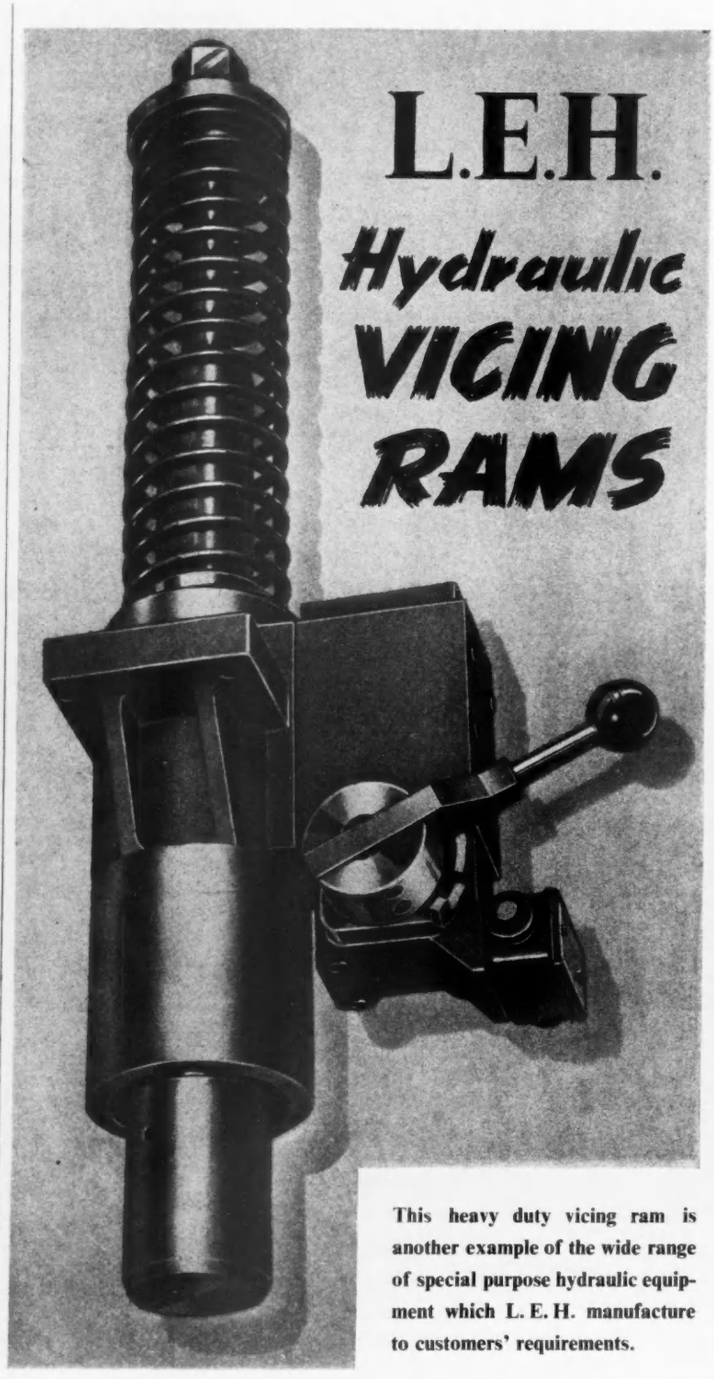

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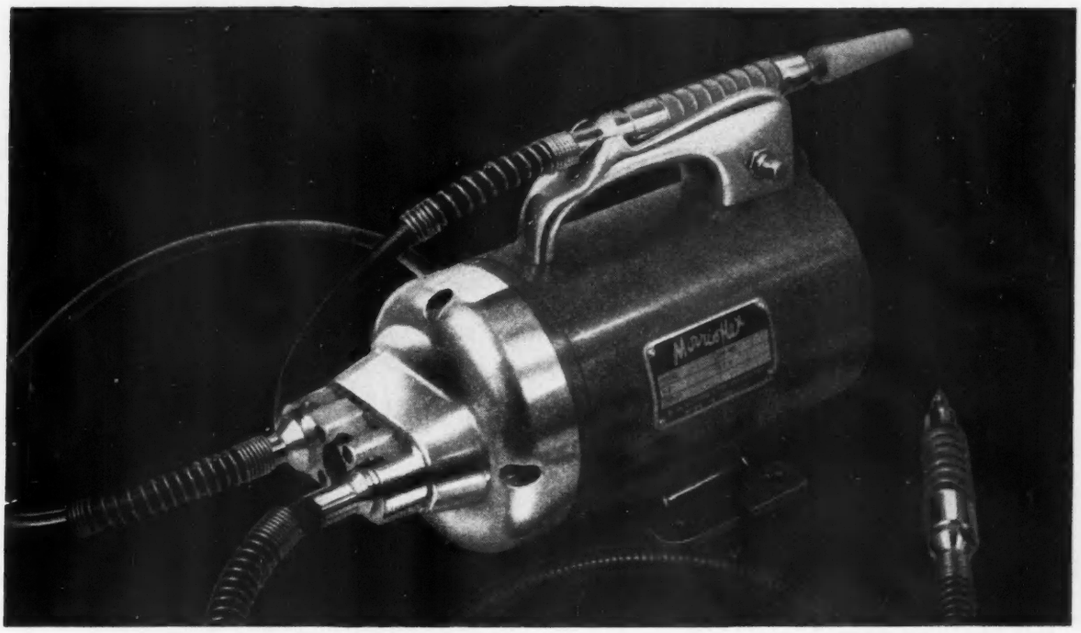

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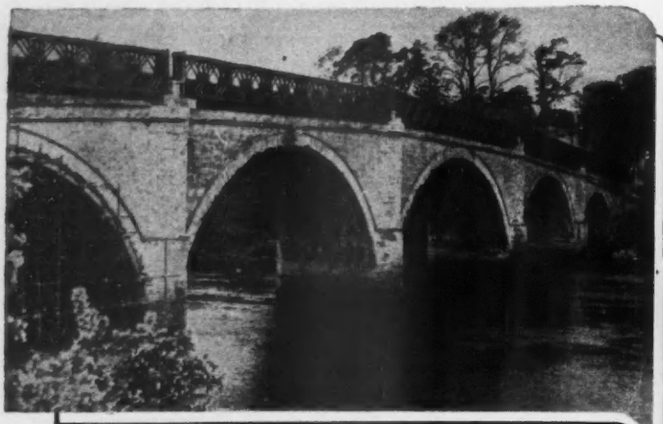

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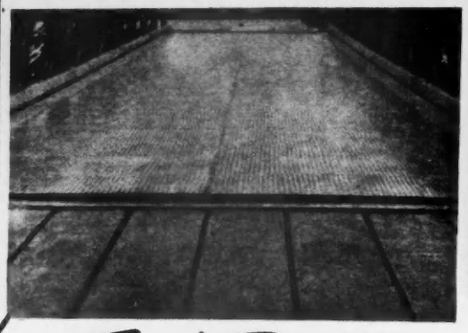

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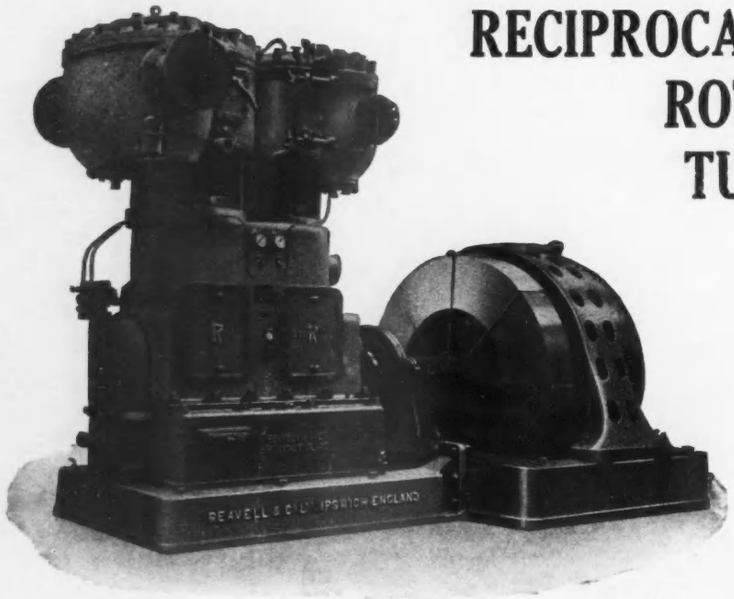

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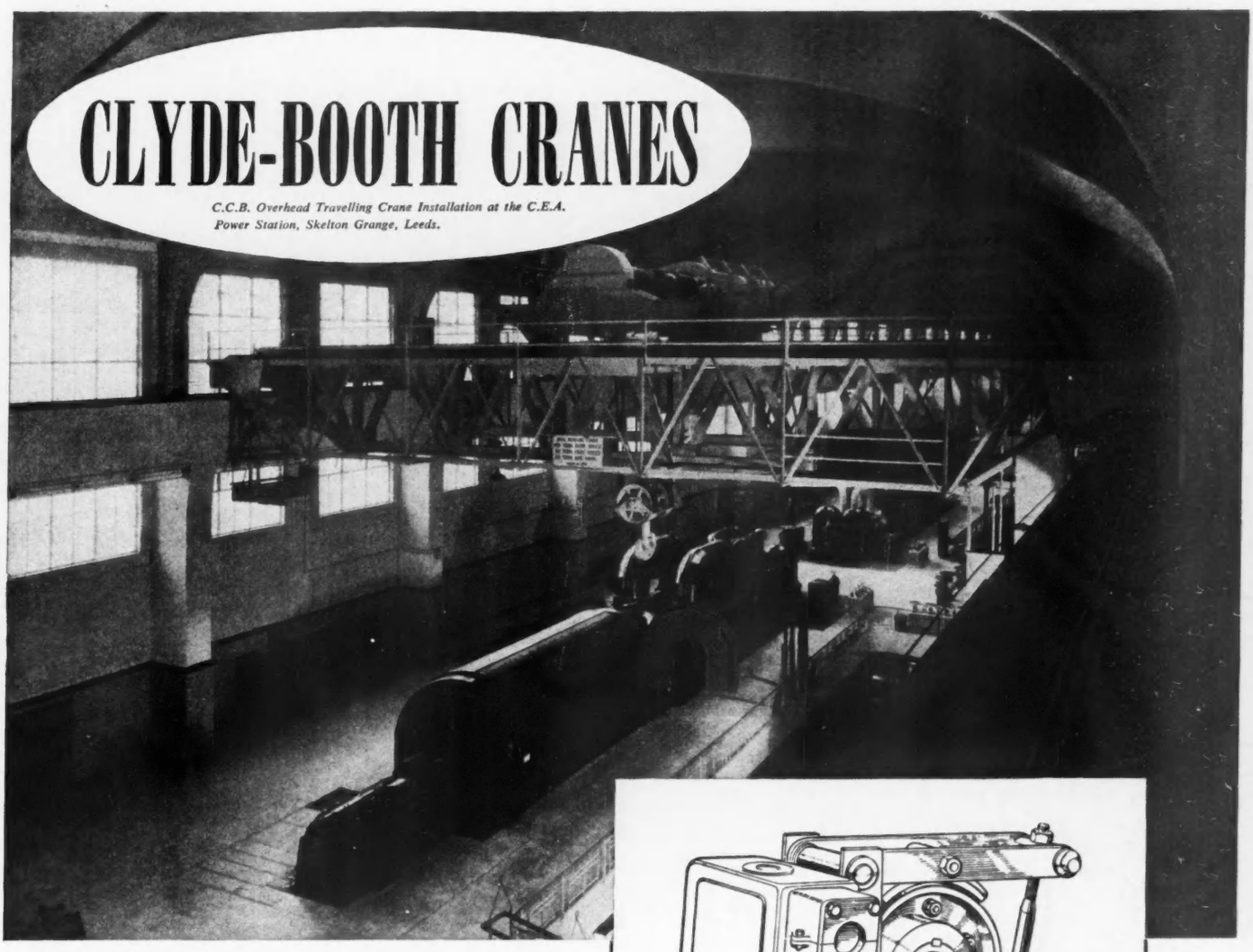

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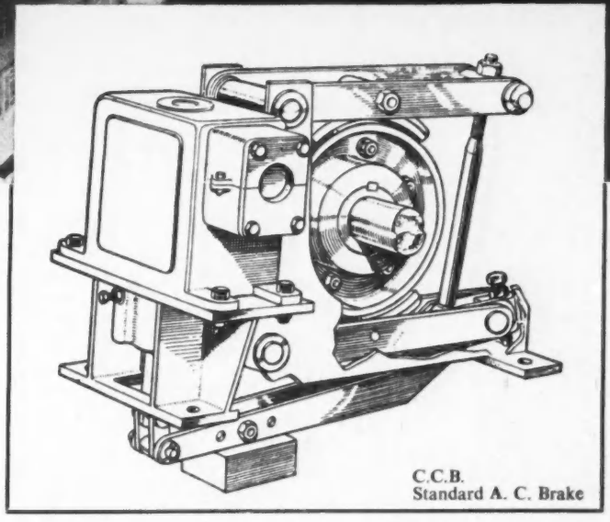

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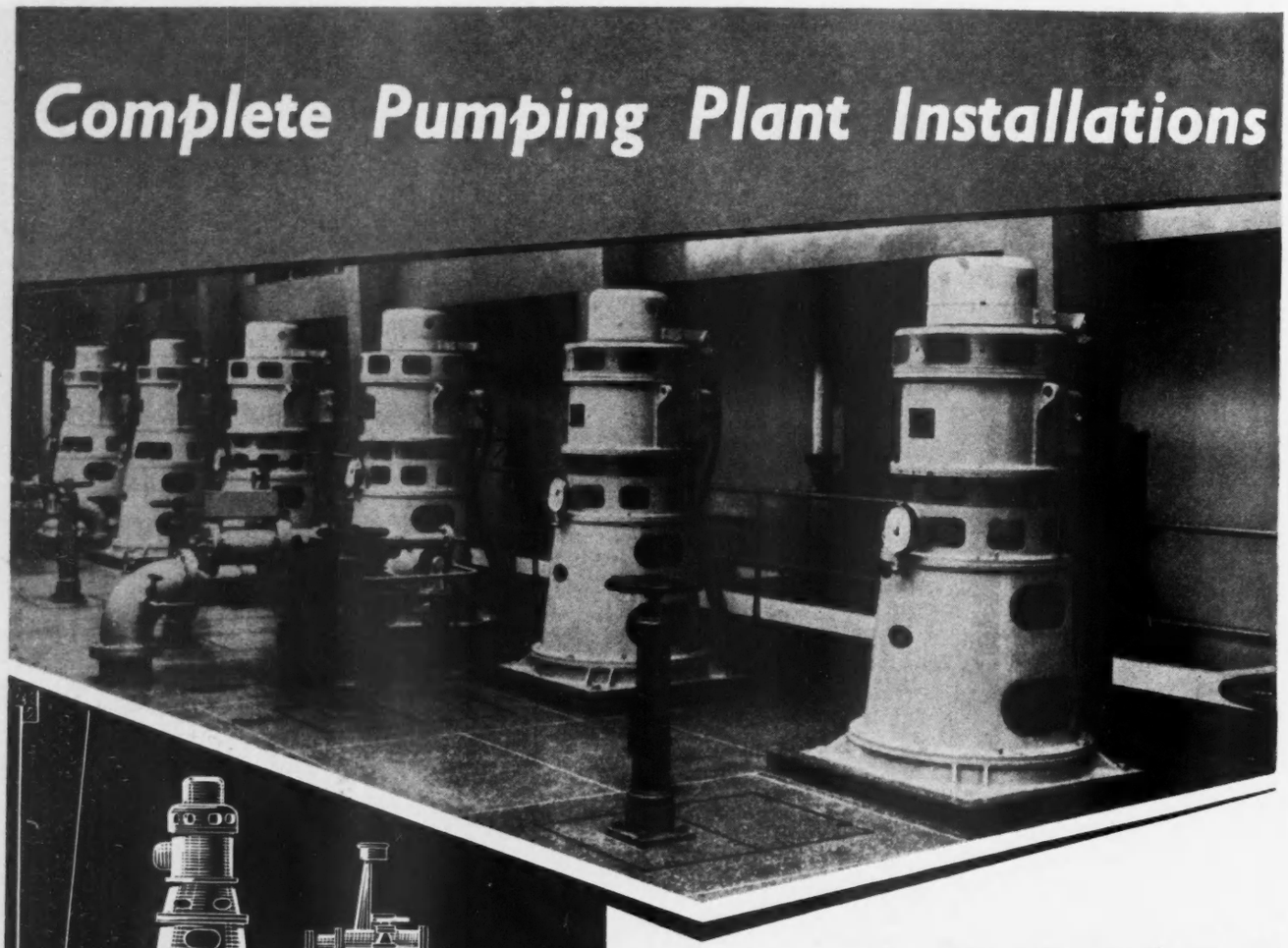

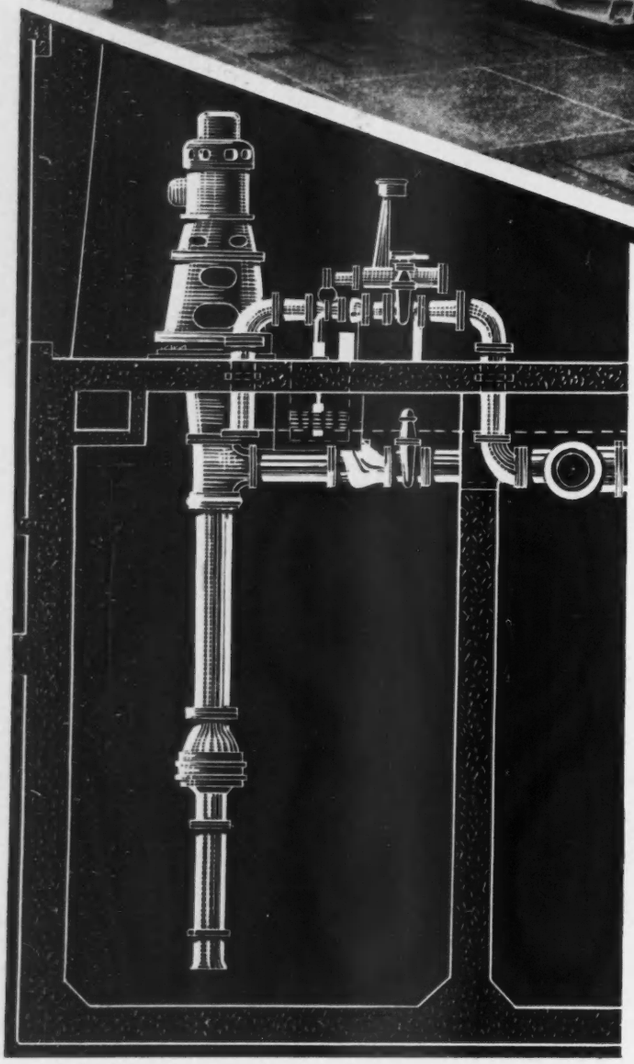

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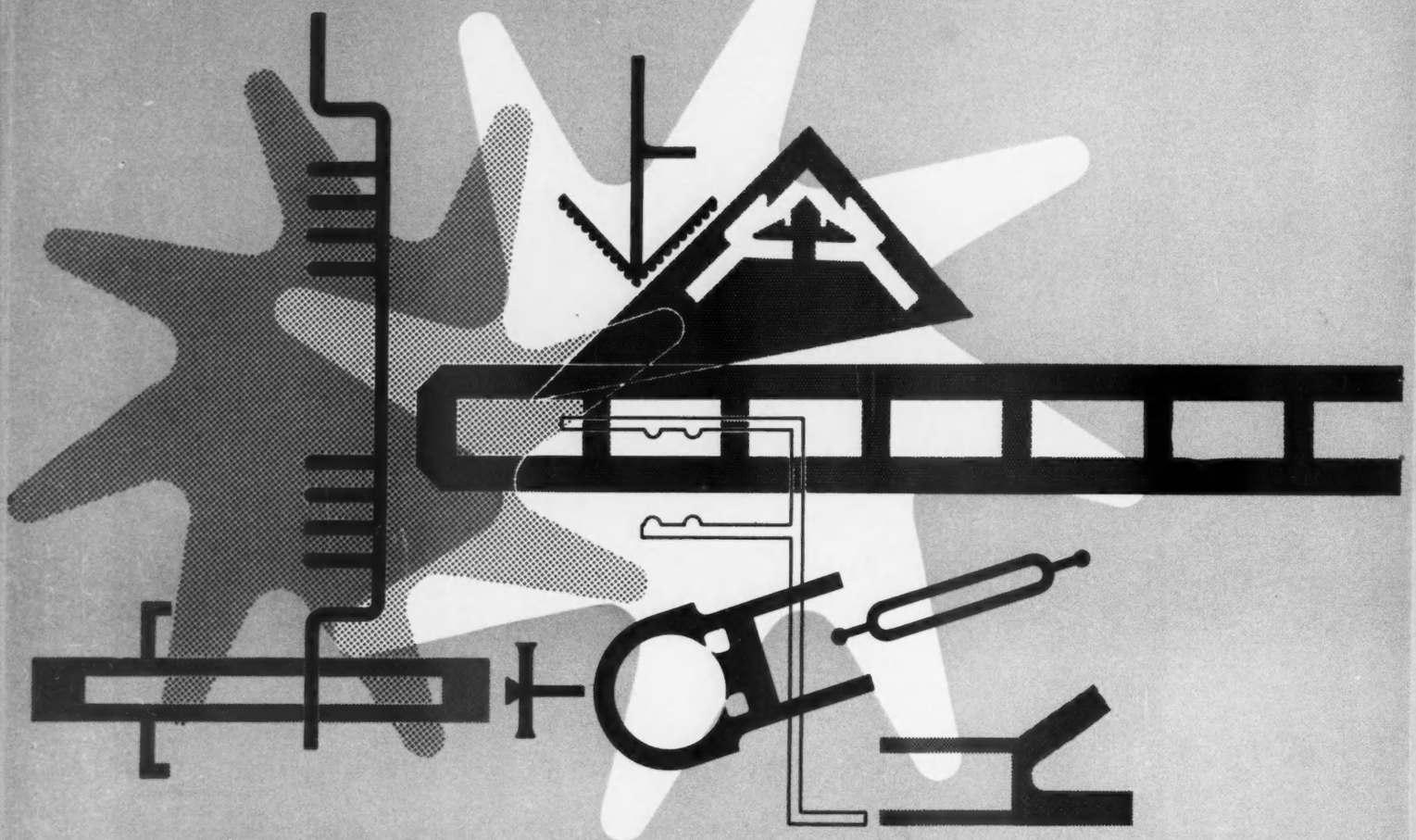

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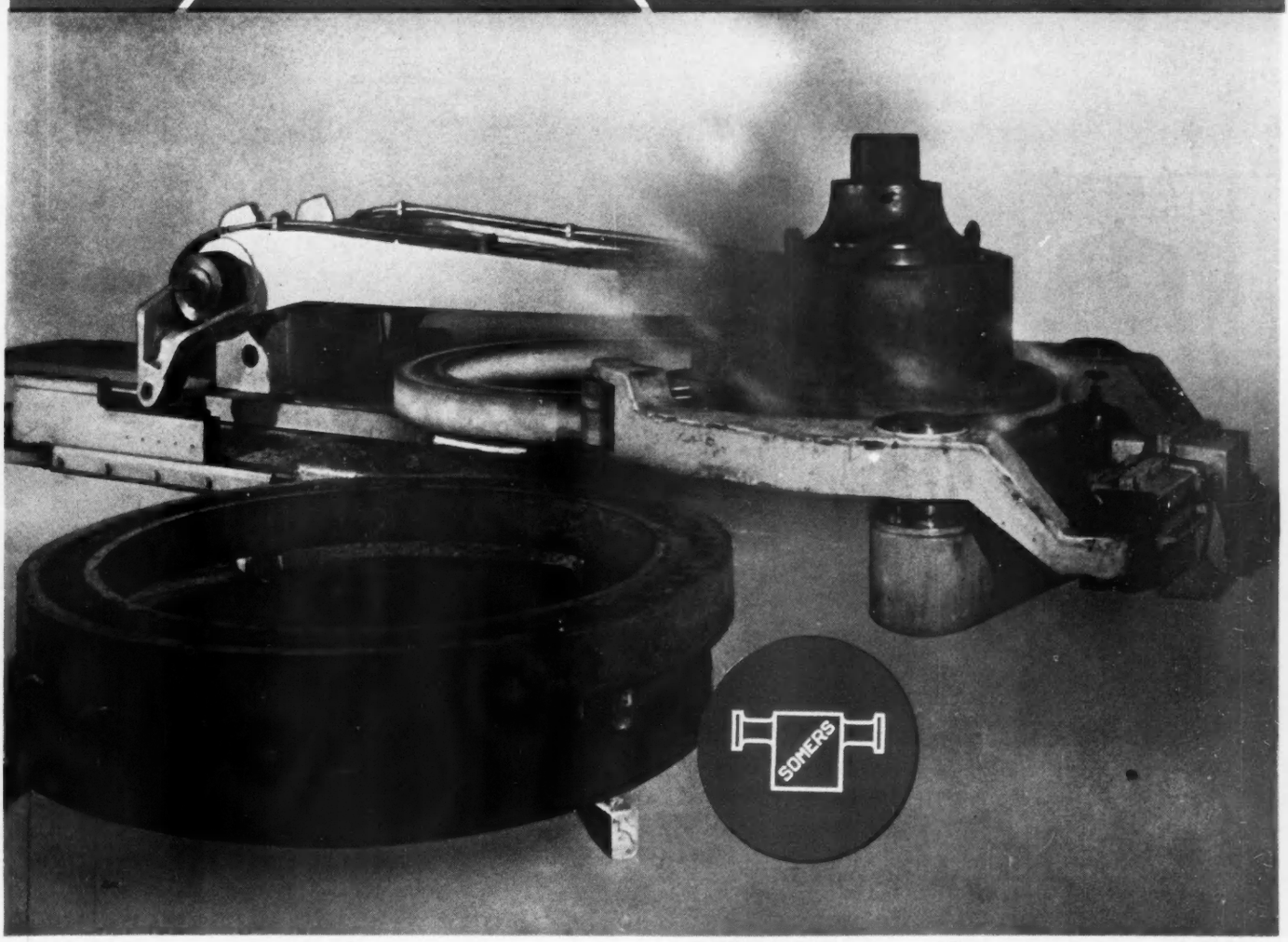

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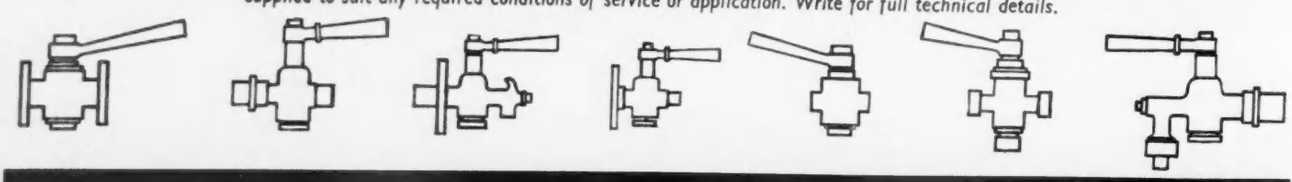

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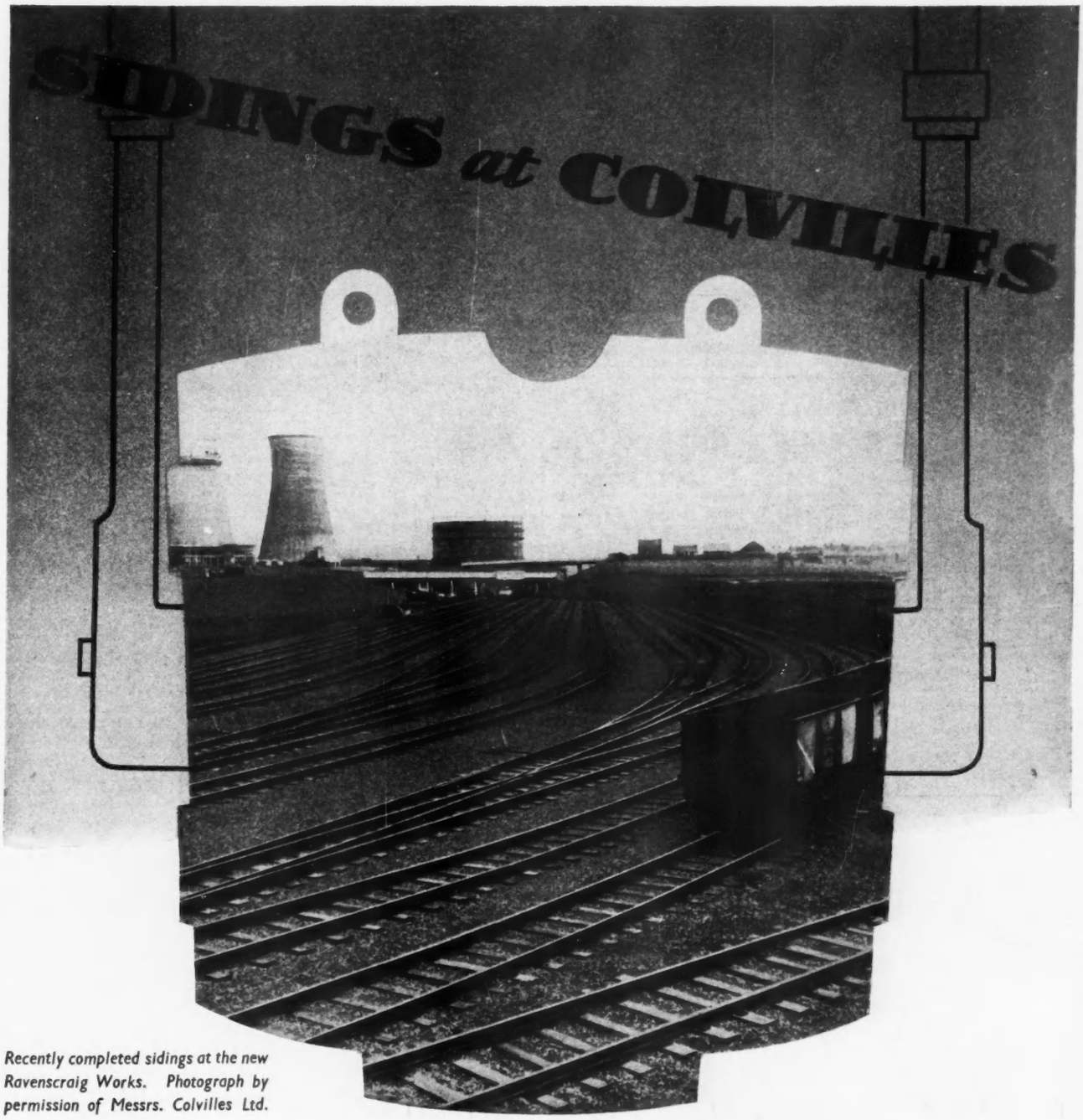

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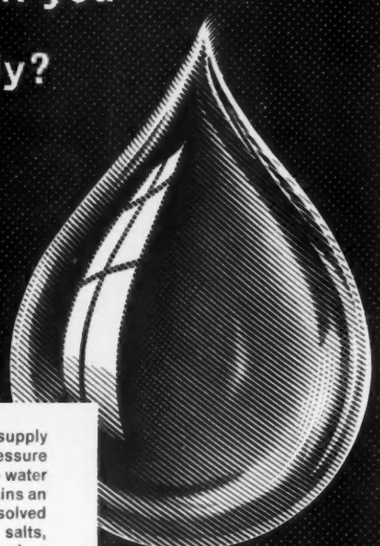

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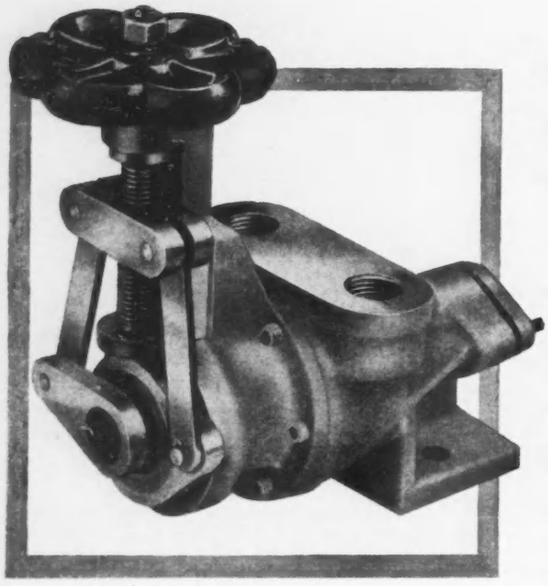

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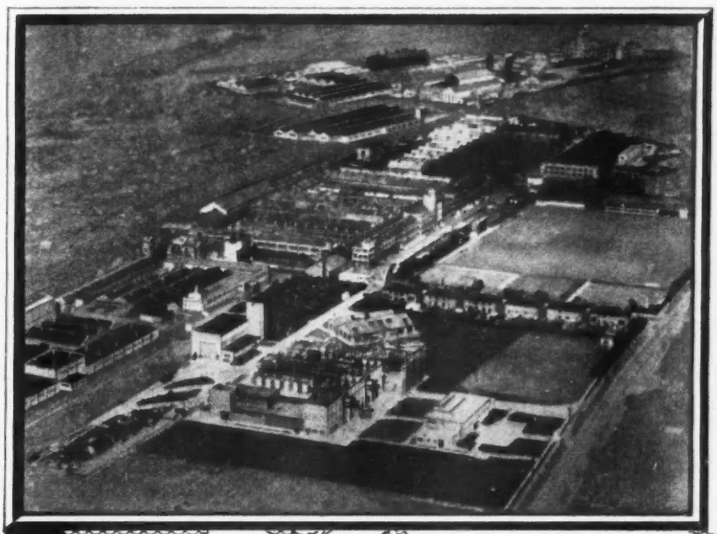

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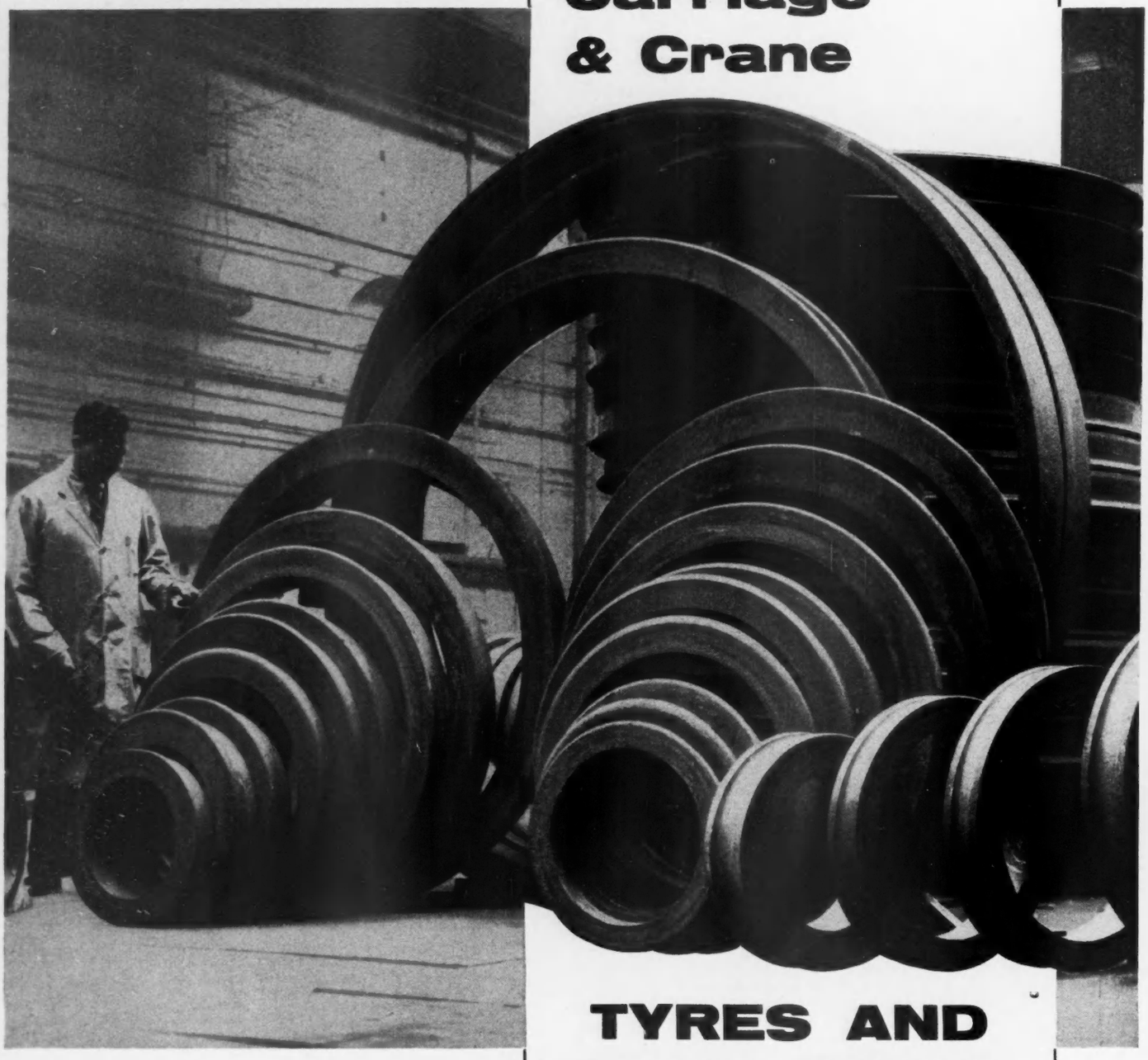

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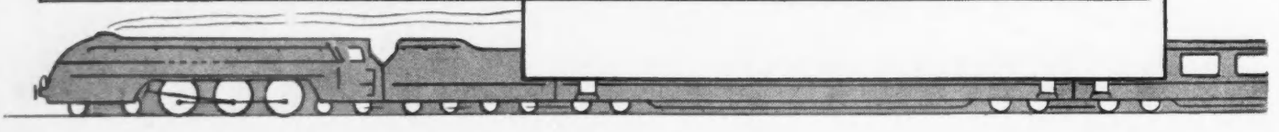

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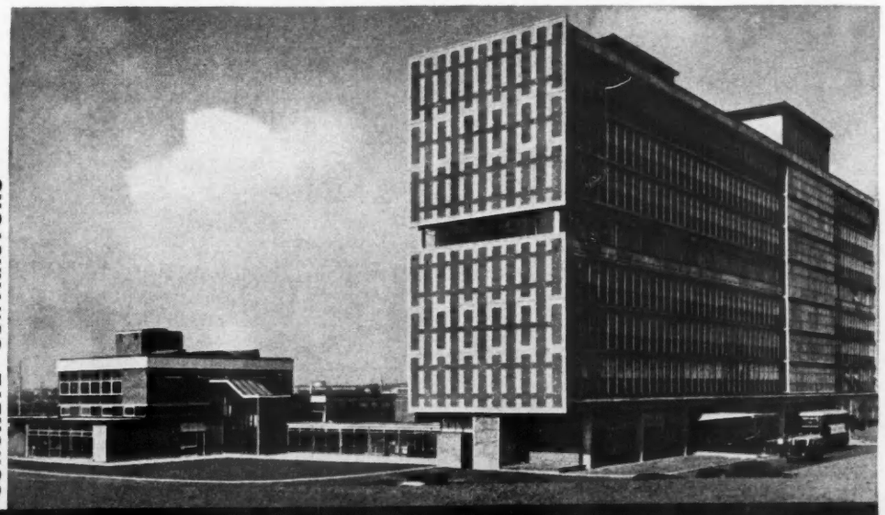

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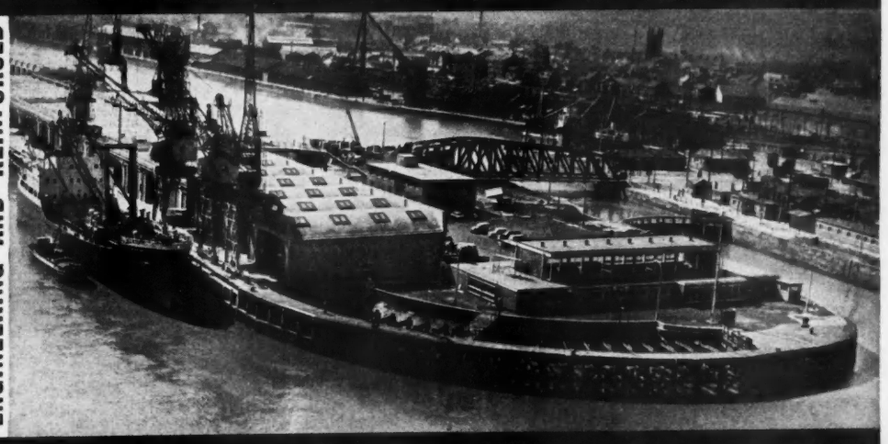

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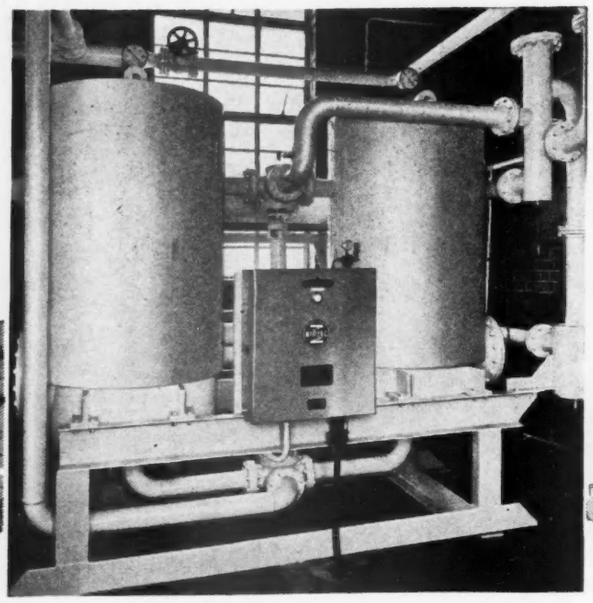

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ENGINEERING Impact

of Ferment in Farm Power

For rapid technical development and expansion it is becoming automatic to turn to electronics and nuclear applications for examples. Yet for an industry with an output from each worker as high as almost any in the country, and with an unbeatable record of breaking into the United States' market, it is worth turning right back to farming and the agricultural engineering industry. There are five industries in the United Kingdom that each export products worth more than £100 million every year and the agricultural machinery makers are one of them.

Last year the United States imported 10,000 tractors—and 9,800 of them were made in Britain. The British industry, employing 40,000 people and much modern, at times automated, equipment, sent 115,000 tractors abroad in 1959, many to the new nations.

Behind the agricultural engineers' export efforts stands a valuable home market, that of the most mechanised farming nation in the world. British farm productivity is exemplified by a 1959 output worth £1,500 million, 50 per cent more than that of Australia and New Zealand whose farm lands are 40 times larger.

Some of the ferment of ideas and technical innovation came to the surface at Cheltenham in the recent national power farming conference. The director of one manufacturing firm detected future value in a tram-like development —a four-wheel drive tractor carrying four or five furrow ploughs mounted at either end and capable of being driven in both directions. The same director may, in so ingenious a field of applications, live to regret his disregard for the idea of a radio-controlled tractor having any significant contribution to make to farming.

The point was made at Cheltenham that the farm worker should become a better mechanic, able to put right, or avoid, his own troubles. This might reduce the numbers of farm engineers, who in the nature of things are not there when the damage is being done, but it would reduce the number of heartaches among manufacturers confronted with the awful sight of what is sometimes done to their products.

Expansion in Australia

The news that Australia has raised a £12 million loan in London underlines the rate at which the Australian economy is expanding.

In the basic industries, ingot steel production has more than doubled in the past decade. From 1,440,000 tons in 1950, output rose to 3,100,000 tons in 1958. As in other countries the greatest increase in demand came from the car and home appliances industries.

Australian expansion is spread between the major companies and much smaller employers. Half of those employed work in factories of not more than 100 people. Among the recent signs of growth have been the opening of a new £A1 million paint factory near Fremantle, in Western Australia, and the £A1,250,000 expansion plans of one of the largest textile companies in the Dominion.

The assembly and local fabrication activities of the British motor car firms in Australia are a well-known part of their export efforts. As Australian steel grows in strength so the local manufacture must be expected to develop at the expense of direct British-made car exports.

Steel Output and Investment

A great deal of public interest attaches to the performance of the steel industry, and to a situation in which companies whose order books are in splendid health, and whose share quotations have been going up like a lift, are to borrow around £100 million for development—not from the public but from the Government.

On the production side, steel output in January was running at the record average weekly rate of 471,400 tons, a third higher than the level of January twelve months earlier. With the usual seasonal and holiday corrections it now looks as if 1960's production will reach 24 million tons, 20 per cent more than last year.

Home demand, on the two fronts—increased consumption and the change from running down to accumulating stocks—will well take care of this.

The rising British output is part of an improving world pattern. Canada, the Benelux states, Russia, West Germany, France and Japan all set new steel records last year and the world total was at the new level of 318 million tons.

The two most notable developments in the British industry now in hand—the strip mills at Ravenscraig, Scotland, and at Newport, Monmouthshire—are both to be paid for with borrowed Government money. The Scottish mill, for Colville's, was estimated in the first announcement more than a year ago to cost £50 million. Richard Thomas and Baldwin's mill in Monmouthshire, for which £70 million is the expected figure, will be an asset for its still-nationalised owners that may act as a sharp spur to the voices calling for RTB's return to private ownership.

Orders Up Profit Margins Down

A hardening labour position is shown by the latest of the Federation of British Industries' industrial surveys as a warning for the future, but as yet the survey finds little sign of inflationary pressure.

Nothing that has emerged from the provisional rail settlement seems to have disturbed the accuracy of the FBI's report of "optimism about the general business situation." This is the first of the surveys to indicate an increase in industrial building plans for the twelve months to come.

Of the returns on the use of capacity, 45 per cent still said that their level of output was below capacity.

As many as 33 per cent expected to authorise more capital expenditure on buildings in the next twelve months than in the past year against 27 who said they would authorise less. In plant and machinery the proportion was 46 per cent more, 20 per cent less.

There were 25 per cent who said that the average weekly hours worked by each operative were up on the position of four months ago, 68 said the hours were the same and 7 per cent down. 38 per cent found they were employing more people than four months ago and 55 per cent that the rate of new orders was better. The rate of new export orders only was up for the smaller number of 29 per cent.

Average selling prices, compared with four months ago, were down for 16 per cent and up for 12. On average profit margins 31 per cent were down, 14 up.

of IDA and the World's Wealth

After all the talking the shape of the new instrument with which the prosperous nations of the world are to help those emerging from poverty and inertia is beginning to become clear.

In the Treasuries of 68 governments there now lie the terms of the agreement, and the report on it of the directors of the World Bank, for the International Development Association. The articles of this new offshoot of the Bank provide that IDA will come into existence as soon as enough governments have accepted membership to provide 65 per cent of the total initial subscription.

The financial commitments of each state are in general proportion to their contribution to the World Bank's capital. This means that the contribution to IDA of the United States is to be $320,290,000. The United Kingdom is second largest on the list with a contribution of $131,140,000 (£46,836,000). Voting rights, as in the Bank, will be in relation to the size of contribution but, as also in the Bank, this is no guarantee of follow my leader behaviour by the smaller members.

Mr. Khrushchev is for ever proclaiming his eagerness for peaceful but uncompromising economic competition. The degree of strength which the 68 nations put into this new weapon, and the skill with which it is used, will be a vital influence on whether one bloc or another "wins" the race or whether a productive and useful compromise emerges.

Government Urged to Help Consultants

An appeal to the government to assist consulting engineers with the cost of preliminary reports on overseas projects has been made by Mr. J. M. L. Bogle, the chairman of the Association of Consulting Engineers.

The project report is the first step that the consultant takes with a new client, his first introduction to a new department or even a new territory. It is the essential step that leads to all the subsequent work undertaken by the consultant. The report is moreover the spearhead not only of the employment of the consultant himself, but of all the trade and commerce that subsequently comes to his country.

Preparing the report is a very expensive business; a partner is going to make at least one visit to the site, a survey team may have to be supported there for a lengthy period, and finally the report has to be compiled and possibly printed. Yet there is a very high risk that the consultant will not be paid for his labour. Fees for the work which is carried out in the following stages of design and supervision are usually covered by an agreement or by the operation of export credits in some form or other, but the project report has to be undertaken only in the hope that the expense can be recouped later.

Mr. Bogle was speaking after the annual dinner of the association.

and Missile Bases Going Mobile

Coming so soon after the Government's vague but re-assuring promise of financial aid to civil aircraft production and development, the Defence White Paper gives reason for some modest optimism in a number of engineering industries.

The amount to be spent on production and research in the year 1960-61 is to increase by £66 million to £651 million.

Looking in detail into the White Paper the best news appears to be for the shipbuilders, with the aero-engine manufacturers close behind. At last, if far behind its critics, the Ministry of Defence appears to see the point that excellent as the Blue Streak missile may be, if its bases must be at fixed points on land then it is far too vulnerable to attack to be of serious value as a deterrent.

So, investigation is now going on into mobile launchers, either aircraft or submarines, for long-range nuclear warhead delivery. And plainly, since the away-from-base duration of a submarine is almost infinitely more than that of an aircraft, the advantages of the submarine as a rocket base are marked. It is highly relevant that the first order for an all-British submarine propelled by nuclear means is to be placed within the year.

Although the cost of a fleet of such craft may be enormous it will not be prohibitive, within the context of present defence philosophy in the West, if it is the price of giving Britain a viable contribution of her own to the deterrent.

The other, and already established British contribution to the nuclear umbrella is the V-bomber group of the Royal Air Force. For this the White Paper reports the better take-off, range and altitude performance made possible by improved engines and it is plain that this is a direction in which it is intended that movement should continue. It is known that particular hopes are being attached to the ducted-fan engines. There is now greater certainty that they will receive the proper backing.

There is a word of warning for all the firms whose interests still include production of Army equipment, particularly at what the troops know as the sharp end.

The policy in NATO is for interdependence in weapons. The British Army has recently put through its (successful) field trials the Italian 105mm pack howitzer.

The important lesson is that in the increasingly unified European defence forces more and more of the equipment will be made in those countries which have devoted the most exhaustive effort to their development and performance. A good index of our own achievement in this may be the results achieved with the new battle tank. Of this the White Paper records that the new tank may be as outstanding as was the Centurion.

Materials Find New Uses—When Foamed

Foaming has opened up new outlets for many materials, by virtue of lower density, lower cost per unit volume, better insulation, and in some cases flexibility.

The use of foamed plastic materials for such purposes as insulation and packaging is not really an innovation, for expanded ebonite was made in this country in 1920. By the end of the Second World War most plastics had not only been discovered, but also foamed, even if only on a very small scale. Nevertheless recent developments in foaming are always worth looking at by both the manufacturer and the user, if only because the launching of a new material, with say half the previous known density, may mean serious competition for established materials on ground of cost, or may even open the way for quite new design concepts.

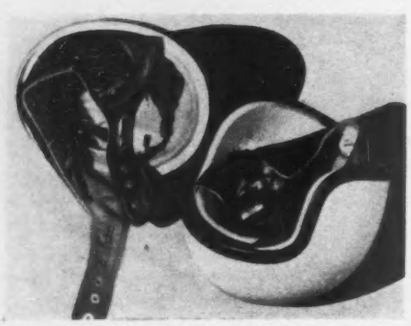
These comments may all sound rather vague but there are two outstanding examples. Firstly the development of rigid phenol formaldehyde foams by Bakelite resulted from the realisation that in its bulk form this plastic just could not compete with insulation materials such as glass wool. Now the density is reduced to a fourtieth in foams weighing only 1 lb per cu. ft, and the material is able to compete with other insulations. Unfortunately for this material there have also been developed several other rigid foams with similar properties, so competition for markets is hot. Then, who would have forseen the wide use which could be made of a polyurethane foam which could be cast *in situ*? Bristol Aircraft have used it for making the Alpha racing dinghy by pouring it between two skins of reinforced plastic, and there are several other similar instances of its use.

There are at the moment eight ways of making foams or expanded materials, and basically similar processes are used for metals, ceramics and for plastics. One of the purposes of bringing these following notes together is to show that there are not many classes of material which have not been tried for foaming. Metals were said by most metallurgists ten years ago to be quite impossible to expand; then Bjorksten Laboratory in the United States put a plastics man on the job, who, by using the principles laid down for foaming plastics, proceeded to devise a process for aluminium which worked. A commercial plant to produce this, incidentally, has just gone on stream, so the material is not just a laboratory curiosity.

How Foaming is Carried out

The first process, which least qualifies for inclusion, is that of bonding fibres. In this, a loose, expended structure can be made by bonding fibres with resinous materials. Second, lightweight refractories are normally made by incorporating a filler which can be removed by oxidation or leached out chemically. Third, if a bulky filler is incorporated which will fuse on heating, this method may be used to leave an expanded structure. However, by far the most widely used are the gas processes, and there are five ways in which a gas medium is employed.

Fig. 1 These motorcycle crash helments are lined with semi-rigid pvc foam.



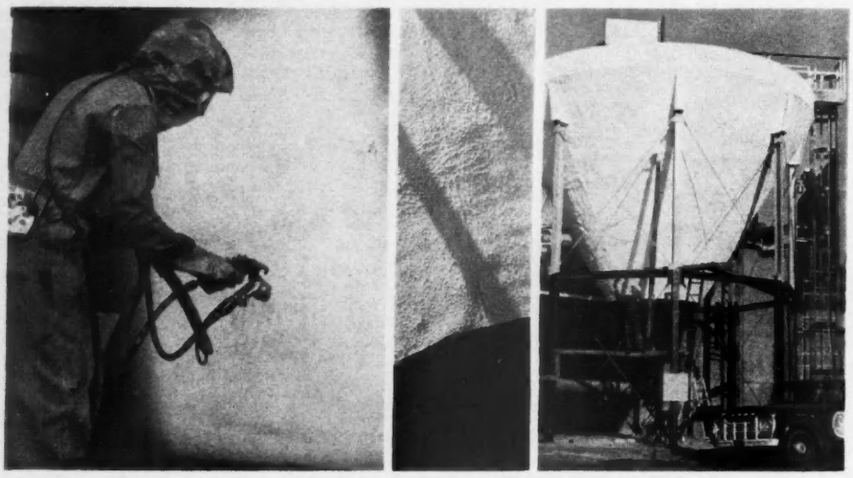


Fig. 2 Spraying chemical tank with Freon-blown polyurethane foam insulation. The bottom of the tank has a further coating of mastic.

Gas expansion.—If gas or a low boiling point solvent is mixed under pressure with a liquid which is on the point of solidifying, and the body is suddenly let down to atmospheric or reduced pressure, then the escaping gas will form bubbles. This process is used for expanding pvc, and very low conductivity foams have been obtained by gas blowing with hydrocarbons such as Freon. Second, gas can be introduced directly into a solidifying mass; which is a process little used. Third comes aeration or frothing, carried out under agitation, which is the method by which most rubber latices are made. Fourth, a chemical can be mixed with the liquid which, during the solidifying heat treatment, decomposes; this is the basis of many proprietory chemical blowing agents such as those based on the chemical hydrazine, which on heating decomposes to give

Typical Properties of Foamed Materials

Material, foamed or expanded	Density, lb/cu. ft	Temperature, °C, max for continuous use	Flammability	Thermal conductivity, Btu/hr/sq. ft/°F/in	Compressive strength lb/sq. in	How made	Main uses
Glass	11	450	Will not burn	0·48	110	—	High temperature and sandwich core insulation
Silica	10—12	1,200	Will not burn	0·48 (50°C) 1·85 (500°C)	130—200	—	High temperature insulation
Aluminium	20—70 40	450	Will not burn	18	6,000	Chemical reaction	Sandwich core and floats
Silicon carbide	17—33	Inert 2,000 oxid. 1,600	Will not burn	7—12	85—750	—	High temperature insulation
Latex	7	—	Burns	—	—	Froth or freeze-blow	Upholstery
Neoprene	15—20	60	Burns	0·33	—	—	High temperature or oil-resistant insulation
Urea formaldehyde	1	100	Burns slowly	0·23	—	Froth	Low temperature thermal or acoustical insulation
Phenol formaldehyde	1—25 1 8	100	Burns slowly	0·24 0·28	5 45	Chemical blow	Buoyancy units, thermal insulation and packaging
Rigid polyurethane	1—35 5	150	Can be made self-extinguishing	0·30	—	Reaction	Insulation, core poured *in situ*
	2	—		0·14	—	Chemical blow	Sprayed insulation
Flexible polyurethane	1—30	100	Can be made self-extinguishing	0·22	—	Chemical reaction	Upholstery and packaging
Ebonite	4	50	Self-extinguishing	0·20	—	—	Low vapour transmission thermal insulation
Polystyrene	2—20	60	Special grade extinguishing	0·22	20	Chemical blow	Sandwich insulation core
Pvc	2—4 3	50	Self-extinguishing	0·23	55	Chemical blow or gas blow	Flexible for upholstery, semi-flexible for shock mountings and cores
Cellulose acetate	7	95	Burns	0·31	200	Solvent evaporation	Sandwich core and packaging
Silicone	12—20 12	300	Smoulders	0·3	100	Chemical blow	High temperature insulation, high or low temperature gaskets and seals
Polyethylene	12	90	Burns	—	—	Chemical blow	Electric cable insulation
Epoxy	2—10 3	—	—	—	65	Chemical blow	Electronic component encapsulation

gases including nitrogen. Finally, the gas can derive from chemical reaction between different parts of the formulation; this has been made famous by the reaction for making polyurethanes, where the combination of polyester, water and diisocyanate produces carbon dioxide which expands the mix as it solidifies.

Rubber Latex

The first commercial production of foamed latex began in England in 1935. There are two processes, the first of which is a straight aeration or frothing process known as the Dunlop process. Since a latex is a stabilised dispersion of rubber in a solvent which is usually water, the aerated solution must be chemically modified to make the rubber coagulate into a continuous structure of membranes which will subsequently permit the solvent to be removed. Coagulation is most usually brought about by adding sodium silicofluoride to the aerated solution immediately prior to pouring into moulds. When this has solidified, it can be vulcanised, washed and dried. The success of the process is dependant on having a latex with high solids content, and much work has been performed to make these. In the second, Talalay, process a combination of freezing and injection of carbon dioxide is used to obtain coagulation, while peroxides are added to produce gas for bubble formation.

Minimum density.—The largest outlet for rubber latices is in upholstery where their desirable properties of resilience and low compression set are virtually unchallenged; that is, except at low densities, for rubber is limited to a lower figure of about 7 lb per cu. ft whereas pvc and urethane foams can be made at a quarter of this. Comparing a rubber latex with a pvc and urethane foam all of 7 lb per cu. ft, the compression set is typically 5 per cent compared with 18 and 17 respectively, while the elongation at break is 380 per cent compared with 190 and 250.

Synthetic foam.—The synthetic rubber industry is very energetic in America, but even there there is reticence in its use for foams. However, Polymer Corporation have recently announced a new styrene-butadiene latex which is said to give foams with low compression set, and Goodyear Tire and Rubber Company are now making Pliolite 5352 latex at their Akron plant, which is a white rubber and is said to yield foams having ageing properties "twice as good as from natural latex."

Silicone rubbers are now being chemically blown into foam, and the specialist rubbers, Hypalon and Viton, have also been successfully expanded. Neoprene undergoes the expanding treatment without objection although only to high densities. It is made in the UK by Expanded Rubber Company who recommend it for high temperature and oil resisting insulation.

Whether ebonite is best considered as a heavily vulcanised rubber or a plastic, the fact remains that the expanded product was made in the 1920's and is still considered the best available for thermal insulation coupled with low vapour transmission.

Plastics

As was said in the introduction, most plastics have been foamed. Rather than attempt to fully review these, the main characteristics have been included in the table together with main properties and uses. There is a great deal unsaid in this, and the absence of data does not mean that this is not obtainable. For instance, it is difficult to quote a compressive strength for many foams, because some have a yield point and some are completely elastic. With the polyurethanes and pvc it depends on what polyester is used or what plasticisers are added, and on whether the pores are separated or interconnected, as to what compression characteristics are produced.

Open or closed.—Once a foamed plastic is classified as having open or closed cell its potential uses are numbered. Interconnected cell types are absorbent and are used primarily for toilet sponges, for upholstery and packaging, while closed cell types are used mainly for thermal insulation, buoyancy units, and as core materials for sandwich construction. In the first category are found both flexible pvc and polyurethane.

Pvc is quite widely used in automobile upholstery because it can be heat sealed by such methods as high frequency induction welding. Furthermore, it can be reprocessed as the basic material is thermoplastic. Fig. 1 illustrates the use of such flexible pvc foam for packaging—protection of the human head against impact. The brand used in this instance was Plasticell, which is a closed cell pvc which can be either flexible or rigid.

Flexible polyurethane foams.—These have the advantage over other foams in that they have very good adhesion and can be cast *in situ*. A clear case of their use for packaging is in protection of an instrument package in the Atlas missile. Here, two outer shells of 20 lb per cu. ft foam were clamped around the instruments and into the space between was poured an inner core of 6 lb foam. This double protection was said to withstand decelerations of 45,000 *g*. Among the odd uses of flexible polyurethane may be numbered the infilling for tyres, where it is sold under the name of Polyrubber by American Latex Products. Tesamoll self-adhesive foam strip is the same basic material, and a bitumen-impregnated version is marketed by Thos. W. Ward for the building trade under the name Compri-Strip.

Rigid foams.—Structural sandwich laminates are probably the greatest potential outlet for phenol formaldehyde foams because, even at the lowest densities of 1 lb per cu. ft, they only just compete with other insulants such as glass fibre. When a weather-resistant surface laminate turns up they could help make a versatile outside cladding material. Already Bakelite have satisfactorily bonded the core to plastic-coated steel such as Stelvetite, and to filled glass/polyester panels.

Polystyrene is making a bid as a thermal insulation material and at one time was going to be used as insulation for an American refrigerator. Its vapour permeability is rather high, however. Rigid pvc foam, although difficult to bond to other laminates, is now being satisfactorily built into sandwich constructions, an example of which is the bulkhead fittings for the Bristol Britannia airliner. The Plasticell version is made by fusing together expanded spheres of pvc, and the resultant structure, which is similar in foamed polystyrene, has high strength-to-weight.

Urethane foams take their share of thermal insulation; one instance, in construction of a school building in Scotland, a ½ in thick layer of insulation was interleaved between plywood on one side and glass-reinforced polyester on the other. For the atomic submarines, Skipjack, Triton and Scorpion, made by the Electric Boat Division of General Dynamics Corporation, 20,000 lb of urethane foam were cast *in situ* at a density of 20 lb per cu. ft, which is said to have saved 8½ tons in each vessel.

Sprayed insulation.—One of the attractions of polyurethane foams is that they may be sprayed on surfaces to act as thermal insulation. Fig. 2 shows application of a Freon blown polyurethane to a chemical-containing vessel; the thermal conductivity of such foams is very low, having K values of 0·14, that is, until the hydrocarbon gas diffuses out of the pores. Very recently, American Army technicians have demonstrated fabrication of 1½ in thick outdoor shelters by spraying the foam on to an inflated canvas hemisphere. Doors and windows can be cut in the walls within an hour.

Ceramics and Glass

Carborundum Company in the United States have developed silicon carbide foam for use as an insulating material up to 2,000° C in an inert atmosphere. This is in pilot plant production, and can be faced with self-bonded silicon carbide to give it better abrasion and erosion resistance.

Silica and glass.—Fig. 3 illustrates use of Pittsburgh Corning Foamsil in insulation of a high temperature aircraft test chamber for McDonnel Aircraft Corporation. This material was fully discussed in ENGINEERING, 20 March, '59, vol. 187, p. 379. In the table in this present article, the properties of foamed glass were taken from a Czechoslovak source. Their product is called Spumavit and is being launched primarily as a building insulation material for use in sandwich construction; the recommended method of binding is with a bituminous mix. This material was used for panels which lined the Czechoslovak pavilion at Brussels World Exhibition in 1958. The American equivalent product, called Foamglas, has recently been used for insulating tanks for liquid propane storage at Riverdale, Georgia.

Fig. 3 Foamed silica is supported by metal for high temperature insulation.

Aluminium "French Bread"

When Bjorksten Laboratories made their first foamed aluminium they described it as like a lump of French bread. That, however, was in late 1957. Now the process has been licenced out to two firms, one of which, Dynamic Metals, Ind., went into production with a 6 million lb a year plant in November, 1959. The product is now much more consistent in texture and weighs 12 lb per cu. ft. It is being promoted for use in roofing and building panels at a cost of about 7*s* per lb (or per sq. ft of 1 in thick material).

Nickel, copper and cast iron.—The first alloy to be foamed by Dynamic Metals is a 10Mg-aluminium alloy, but the company is now working with Mg-Si-aluminium alloys which should be cheaper. The foaming is produced by mixing zirconium hydride with the molten metal as it is about to solidify. General Electric in the US have also developed a foaming method, only theirs seems to involve casting the metal with an additive which releases gas during subsequent high temperature heat treatment. Apparently, nickel, copper, and cast iron have been foamed in addition to one called F-alloy which they have found useful for rubbing seals in high temperature areas of jet engines.

Plain Words

By Capricorn

I have the gift of looking guilty. A small crime is uncovered and I feel that every eye is on me. I may not actually have done it but my blushes draw suspicion.

How often we are caught in a web of circumstantial evidence. You know the situation: one is just picking out the shortcomings of a rival company's advertisement in a popular newspaper when in walks the boss. And at that moment you notice for the first time that the advertisement is adjacent to a comic strip. The boss peers over your shoulder and mutters brusquely: "Let me have those figures before lunchtime, will you, Sellers?"

Well it's just the same with me. On his arrival the other morning, a colleague called into my office to discuss some work he was doing. He tossed his coat on to the bookcase and forgot it. So did I until I spotted it about 10.30. With my customary courtesy I picked it up and walked out into the corridor to hang it on a peg. Who should then walk past but the managing director. "Morning Sellers," he said coldly. "Morning sir," said I.

He even remembered my name. I'd like to bet if I'd been working late one evening, he wouldn't even have noticed me. And that morning, the morning I was hanging up a coat at 10.30, I'd been there at 8.15.

What was I to say? "Just hanging up Johnson's coat, sir." Or something like: "Always so preoccupied with work, sir, never think to hang up my coat"—said, of course, with a gay smile and a careless gesture. Or maybe the thing is to be bold: "You're early this morning, sir; my head, what a night!" But I couldn't carry it off.

I could just imagine him sitting there, with his neat bare desk and virgin blotter, thinking: "Ah, Sellers. Used to be so keen; started to take it easy now he's established. A fine time to get to the office. I suppose he's got his work so well organised, he hasn't anything to do. I wonder if we really need a junior drafting manager?"

Sometimes I wish people weren't so diffident about reprimanding you. At least a spoken criticism gives you chance to put your point of view. Now if the MD had said: "You're damn late this morning, Sellers," I should have been able to reply, give him the facts, tell him how early I arrive, how late I leave. I bet there are hundreds of people harbouring anxiety because the boss just gives them a dirty look instead of having the matter out. So much better to say: "Look here, Sellers, do you have to read Colonel Pewter in office hours?"

Damn, there goes the telephone.

It was the managing director. He wanted to see me. "Sellers," he said, "I've noticed how early you get in each morning. I appreciate your conscientiousness, but it has a disturbing influence on other members of the staff. Try and complete your work within the authorised hours in future, please."

Letters to the Editor

Aesthetic Qualities of Timber

SIR, Your article on "Design in Civil Engineering" in the Outlook 1960 series makes interesting reading and we are in full agreement with what you have to say, with, however, one exception (ENGNG., 22 Jan. '60, p. 143).

We cannot agree with your contention that "On maintenance alone steel and timber lose out to concrete and aluminium alloys for the first two require painting." This may well be so in the case of steel but as timber is not subject to corrosion the necessity for painting does not arise. Where paint is employed it is usually done to provide a given aesthetic treatment. Present tendencies in structural timber are to avoid such treatments and, as you point out, the results are highly satisfactory. Careful design and appreciation of the aesthetic qualities of the material have been combined to produce a new family of engineered timber structures of considerable architectural merit.

You also refer to the question of fire resistance. Too often the emphasis is placed on non-combustibility rather than on structural durability. The length of time a structure will support a load when subjected to fire is, we suggest, of prime importance and yet the favourable properties of timber under such conditions are largely ignored by both architects and engineers.

Yours faithfully,
H. RICHARDSON,
Industrial Relations Officer.
Timber Development Association Limited,
21 College Hill, London, EC4.
15 February, 1960.

Recovering Iron Oxide from the Air

SIR, Your correspondent, Mr. J. E. Sayers, suggests in his letter on the recovery of iron oxide (ENGNG., 12 Feb. '60, p. 216), that dry dust collection from oxygen steelmaking processes offers important advantages over the wet process, and he then describes the method of returning the dust directly to the oxygen steel converter installed at the Donawitz works of the Oesterreichische Alpine Montangesellschaft.

At Ijmuiden, the dust emitted by the L/D converters is removed in a Pease-Anthony venturi gas scrubbing plant from which it is reclaimed in a dry state. It is for convenience sake that it is processed through the sinter plant and blast furnaces, but the dry and coarse granular state in which the oxide is recovered makes it equally suitable for feeding back into the converter. Unlike the very fine particle size of the dust collected from electrical precipitators, the coarse state of the material makes it less likely to be re-entrained as dust in the gas stream leaving the converter.

Your correspondent refers to the necessity of external sludge thickening and clarifying plant, water circulating and cooling arrangements, etc. For the venturi type of wet scrubber, water cooling is not required. The thickening and clarifying plant is standard equipment which can be kept relatively small by the use of the more recently developed S-F venturi scrubber operated with slurry recirculation as a prewasher in place of the earlier quench chamber preceding the P-A venturi scrubber.

When comparing wet and dry processes for the removal of oxide dust produced by oxygen steelmaking plants, the presence of carbon monoxide in the "off-gases" and the temperature at which these gases enter the scrubbing equipment must be considered. Indirect gas cooling by either a water-cooled stack or a waste-heat boiler is a suitable method of reducing the volume of gases from most oxygen steelmaking processes regardless of the type of gas-cleaning equipment, but the manner in which further cooling of the gases is achieved is most important.

Dilution air should be kept to a minimum, as there is no virtue in scrubbing clean air. Low quantities of dilution air will result in a high carbon monoxide content of the gases to be cleaned. This can be an explosion hazard in the electrical precipitator but of no danger in the venturi scrubber. Very high gas temperatures resulting from small quantities of dilution air present no problems for the venturi scrubber, whereas further cooling of the gases by either large quantities of dilution air or by cooling towers is required when using gas-cleaning equipment with temperature limitations.

Gas scrubbing installations utilising P-A venturi scrubbers have been installed in Europe, America and Japan. Others are, at present, being erected and a number more are being planned for the Rotor and Kaldo oxygen steelmaking processes in addition to the L/D process referred to by your correspondent.

Yours very truly,
A. M. HUNTER,
Manager, Gas Scrubber Division.
Chemical Construction (GB) Limited,
9 Henrietta Place, London, W1.
16 February, 1960.

No-Tunnel Crossing

SIR, I was extremely interested in your article entitled "Crossing the Channel Without a Tunnel" (ENGNG., 5 Feb. '60, p. 188).

While you point out the growth in cars crossing by sea, I find that since I last crossed—Dover to Boulogne in 1957—in booking again this year, there are actually fewer crossings available than before. It would appear, therefore, that British Railways are making less effort to meet the situation.

Yours faithfully,
A. E. PICKERING.
Stewarts and Lloyds Limited,
Pudding Mill Lane,
Bow, London, E15.
19 February, 1960.

Draughts in the Room

SIR, I should like to refer to your article entitled "No-Draught Fires" (ENGNG., 15 Jan. '60, p. 108). The implication of this article, which described a number of fires having underfloor draught, was that the incorporation of the latter for the combustion of the fuel, solved the problem of excessive room draughts. Nothing could, of course, be further from the truth, since the arrangements described supply only the combustion air and this amounts on average burning rates to less than one-tenth of the air passing over the top of the burning fuel to the chimney.

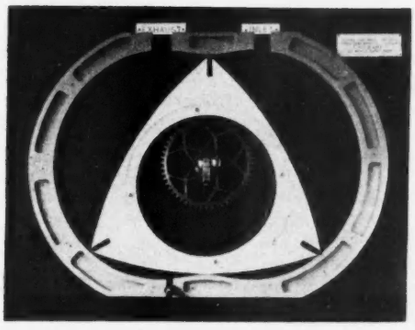
The use of a hearth grille and convection passages around the fire also connected to the underfloor air (as incorporated in a deep-ash-convector open fire developed by this Association very many years ago) did go some way to reduce the excess room ventilation. But for the complete elimination of unwanted room draughts and incidentally for the much needed increase in efficiency of open fires, the free-standing convector fire with adjustable restricted throat (again developed by this Association several years ago and now used in a range of appliances) provides the complete answer. By all means let us have bigger and better ash boxes and underfloor air, but don't imply that the arrangements described will eliminate room draughts.

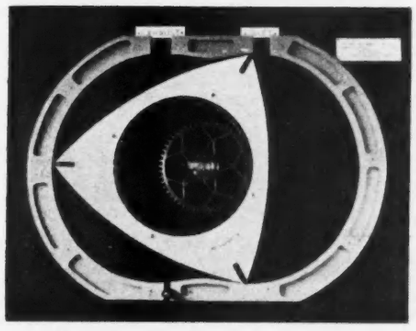
Yours faithfully,
J. S. HALES,
Director of Industrial and Domestic
Development Laboratories.
The British Coal Utilisation Research
Association,
Randalls Road, Leatherhead.
18 February, 1960.

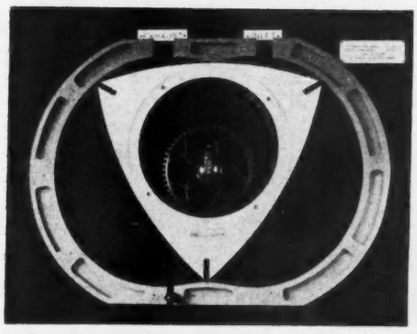
NSU-Wankel Engine

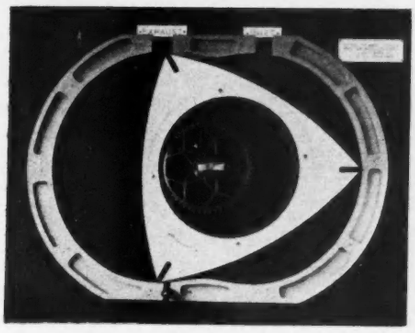
SIR, Correspondents who have written to you regarding the NSU-Wankel engine may be interested in a teaching model of this engine which has been made by Mr. A. Barker in the workshops of the Cambridge University Department of Engineering. The accompanying four illustrations of this model were taken to show the rotation through each 90° of the planet carrier, which is the output shaft of the engine.

The fixed sun-wheel consists of an old chain-wheel from a bicycle. The internal gear on the rotor consists of a length of chain sprung into position. The ratio of the teeth numbers is 3 : 2. The output shaft is at the back from the carrier.





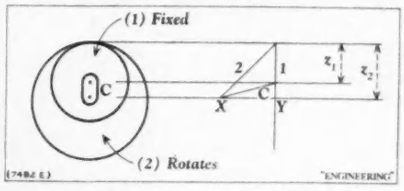




A teaching model of the NSU-Wankel engine showing the rotation of its planet carrier through each of four 90° movements.

The shape of the rotor was drawn from photographs which have appeared in the press; a tip of the rotor was used to generate the shape to which the case had to be made in wood.

For a three-lobed rotor, the carrier must rotate through 90° while the rotor rotates through 30°. The analysis of the epicyclic mechanism is:—



$$\text{Angular velocity of carrier} = \frac{XY}{z_2 - z_1}$$

$$\text{Angular velocity of 2} = \frac{XY}{z_2}$$

$$\text{But } \frac{z_2}{z_2 - z_1} = 3$$

$$\therefore \quad 3z_1 = 2z_2$$

This might give $z_1 = 20$, $z_2 = 30$ as shown in illustrations published in the technical press.

Yours faithfully,
D. B. WELBOURN.

Engineering Laboratory,
University of Cambridge,
Trumpington Street, Cambridge.
11 February, 1960.

Russian Profits

SIR, My letter on how taxes on companies aid Russia has been misunderstood by Mr. Pat Sloan, who refers to the "profits" of Russian industry. (ENGNG, 12 Feb. '60, p. 216.)

I merely pointed out, for the benefit of the Chancellor of the Exchequer and anyone else interested in seeing the West maintain its competitive position *vis-à-vis* the East, that it appears that our system of company taxes gives the Russians a 5 per cent (or more) start in the productivity race, as no scheme with a return of under 10 per cent is considered in the West.

I had hoped that someone would prove me in error.

Yours faithfully,
J. B. ALDRED,
Director.

Shirley Aldred and Company Limited,
Worksop.
17 February, 1960.

Events in Advance

Advances in Mechanical Handling

An industrial revolution, dating back to man's invention of the wheel, is still in progress, growing constantly in vigour and scope under its modern title mechanical handling.

Nowadays, the subject embraces a wide field of labour-saving machinery, ranging from aerial ropeways and bottling plants to cranes, fork trucks, conveyors and electronic control equipment. Every other year, an exhibition covering apparatus of this nature is held at Earl's Court, London, SW5. Occupying more than half-a-million square feet of floor space, this year's Mechanical Handling Exhibition will be held from 3 to 13 May and will be open from 10 a.m. to 6 p.m. daily, with the exception of Sunday, 8 May.

A special feature of the event will be the holding of a symposium of industrial films, as a means of bringing to the notice of visitors recent developments in some of the larger mechanical-handling installations which are too large for exhibition at Earl's Court. These films will cover applications of many different types of equipment in a variety of industries. The programme has been divided into two sections: the one covering films of a general character and the other dealing with exhibitors' own films showing their equipment in use.

Visitors from rather more than 80 countries are expected to attend the exhibition, which is being organised by the Iliffe journal *Mechanical Handling* and programmes of the film sessions, as well as admission tickets (supplied free of cost) and other information are obtainable from the organiser, Mechanical Handling Exhibition, Dorset House, Stamford Street, London, SE1. Telephone: WATerloo 3333.

Exhibitions and Conferences

Induction Heating Course, Second.—Tues. and Wed., 1 and 2 Mar., covering theory of induction heating, how the generator works, and the design of coils for hardening, annealing, tempering, brazing and soft soldering. Organised by the Process Heating Division, Pye Ltd. Apply to Mrs. E. Raeburn, Pye Process Heating, 28 James Street Cambridge. Tel. Cambridge 57590.

Agricultural Machinery Exhibition, International.—Tues., 1 Mar., to Sun., 6 Mar., at Paris. Organised by the Union des Exposants de Machines et d'Outillage Agricoles, 95 Rue Saint Lazare, Paris 9.

Ideal Home Exhibition.—Tues., 1 Mar., to Sat., 26 Mar., at Olympia, London, W14. Organised by Associated Newspapers Ltd., 161-163 Queen Victoria Street, London, EC4. Tel. FLEet Street 6000.

Toy Fair, Nuremberg International.—Thurs., 3 Mar., to Tues., 8 Mar., in Nuremberg. Agent: Mr. Neven du Mont, 123 Pall Mall, London, SW1. Tel. WHItehall 8211.

Exploration of the Moon, Symposium.—Sat., 5 Mar., (2.30 p.m. and 5.30 p.m.) at Caxton Hall, off Victoria Street, London, SW1. Organised by the British Interplanetary Society, 12 Bessborough Gardens, London, SW1. Tel. TATe 9371.

Frankfurt International Spring Fair.—Sun., 6 Mar., to Thurs., 10 Mar., at Frankfurt. Agents: Lep Transport Ltd., Sunlight Wharf, Upper Thames Street, London, EC4. Tel. CENtral 5050.

Costs, Profits and the Manager, Residential Course.—Sun., 6 Mar., to Fri., 11 Mar., at Bromley. Inclusive fee £60. Apply to the director, Sundridge Park Management Centre, Bromley, Kent. Tel. Ravensbourne 9821.

EDA Annual Sales Conference.—Tues., 8 Mar., to Fri., 11 Mar., at the Royal Hall, Harrogate. Organised by the British Electrical Development Association, 2 Savoy Hill, London, WC2. Tel. TEMple Bar 9434.

Motor Show, Geneva International.—Thurs., 10 Mar., to Sun., 20 Mar., in Geneva. Organised by the Fondation du Salon de l'Automobile, 1 Place du Lac, Geneva, Switzerland.

Agricultural and Animal Farming Fair, International.—Sun., 13 Mar., to Mon., 21 Mar., at Verona. Apply to the secretary-general, International Agricultural Fair, Palazzo del Pallone, Verona.

Oil and Colour Chemists' Technical Exhibition, 12th.—Tues., 15 Mar., to Thurs., 17 Mar., at the Royal Horticultural Society's New Hall, Greycoat Street, London, SW1. Apply to the Oil and Colour Chemists Association, Wax Chandlers' Hall, Gresham Street, London, EC2. Tel. MONarch 1439.

Non-Destructive Testing, Third International Conference on.—Tues., 15 Mar., to Mon., 21 Mar., at Tokyo and Osaka, Japan. Apply to the British National Committee for Non-Destructive Testing, 1 Birdcage Walk, St. James's Park, London, SW1. Tel. WHItehall 7476.

Computer in Production, Informal Discussion.—Mon. and Tues., 21 and 22 Mar. (10 a.m. to 8 p.m. on first day and 10 a.m. to about 4 p.m. on second day), at the Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. Apply to the Institution at that address. Tel. WHItehall 7476.

Polymeric Progress, Conference on.—Wed. and Thurs., 30 and 31 Mar., at William Beveridge Hall, The University, London, WC1. Organised by the Plastics Institute, 6 Mandeville Place, London, W1. Tel. WELbeck 5439.

Continued on next page

Bahrain Agricultural Show and Trade Fair.—Thurs., 31 Mar., to Thurs., 7 April, at Manama, Bahrain. Apply to the Department of Public Relations and Broadcasting, Manama, Bahrain, Persian Gulf.

"Introduction to Industry" Training Courses.—In April, for boys taking "A" level science subjects, at Chippenham. Two five-day courses, Monday to Friday. Mid-day meals provided; and travelling and lodging expenses paid in appropriate cases. Apply before 1 March to the personnel superintendent, Westinghouse Brake and Signal Co., Ltd., Chippenham, Wilts. Tel. Chippenham 2241.

Brussels International Industries Fair, 33rd.—Sat., 30 April, to Wed., 11 May, at the Palais du Centenaire, Brussels 2. Apply to Belgian Railways, 167 Regent Street, London, W1. Tel. REGent 1491.

Distillation, International Symposium.—Wed., 4 May, to Fri., 6 May, at the Dome, Royal Pavilion, Brighton. Organised jointly by the Chemical Engineering Group, 14 Belgrave Square, London, SW1 (Tel. BELgravia 3647), and the Institution of Chemical Engineers, 16 Belgrave Square, London, SW1. Tel. BELgravia 3647.

Application of Aluminium to Railway Rolling Stock.—Fri., 27 May (10 a.m. and 2.30 p.m.), at the Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. Symposium, organised jointly by the Aluminium Development Association, 33 Grosvenor Street, London, W1 (Tel. MAYfair 7501); and the Institution of Locomotive Engineers, 28 Victoria Street, London, SW1. Tel. ABBey 6672.

Protection of Industrial Property, 24th Congress of the International Association for (AIPPI).—Sat., 28 May, to Sat., 4 June, in London. Apply to the secretary of the organising committee, Mr. H. C. Miller, 16 St. Martins le Grand, London, EC1. Tel. MONarch 8811.

Business Efficiency Exhibition, 47th.—Mon., 3 Oct., to Wed., 12 Oct., at Olympia, London, W14. Organised by Office Appliance and Business Equipment Trades Association of Great Britain and Ireland, 64 Cannon Street, London, EC4. Tel. CENtral 7771.

Motor and Motor Cycle Show, Paris International.—Thurs., 6 Oct., to Sun., 16 Oct., in Paris. Agent: Mr. R. C. Liebman, 178 Fleet Street, London, EC4. Tel. CITy 5889.

Building Trades Exhibition, 23rd.—Tues., 11 Oct., to Sat., 22 Oct., at City Hall, Deansgate, Manchester. Organised by Provincial Exhibitions Ltd., City Hall, Deansgate, Manchester 3. Tel. Deansgate 6363.

Technology of Plastics Processing, International Congress on.—Mon., 17 Oct., to Wed., 19 Oct., in Utrecht. Followed by the **Second International Plastics Exhibition ("macro Plastic").**—Wed., 19 Oct., to Wed., 26 Oct., at the exhibition halls, Utrecht, Netherlands. Organised by N.V.'t Raedthuys Tesselschadestraat 5, Amsterdam, Netherlands.

Measuring Instruments, International Congress and Exhibition (INTERKAMA).—Wed., 19 Oct., to Wed., 26 Oct., at Dusseldorf. Agents: John E. Buck and Co., Ltd., 47 Brewer Street, London, W1. Tel. GERrard 7576.

Motor Show (45th International Motor Exhibition).—Wed., 19 Oct., to Sat., 29 Oct., at Earl's Court, London, SW5. Organised by the Society of Motor Manufacturers and Traders Ltd., Forbes House, Halkin Street, London, SW1. Tel. BELgravia 6611.

Dairy Show, 74th Annual.—Tues., 25 Oct., to Fri., 28 Oct., at Olympia, London, W14. Organised by the British Dairy Farmers' Association, 17 Devonshire Street, London, W1. Tel. LANgham 6903.

Meetings and Papers

Aslib

LONDON
"Special Library Work in the USSR," by Anthony Thompson. Federation of British Industries, 21 Tothill Street, SW1. Tues., 1 Mar., 6 p.m.*

Birmingham Exchange and Engineering Centre

BIRMINGHAM
"Construction of the M.1. Motorway," with film, by D. P. Weeks. Mon., 29 Feb., 6.30 p.m. (Admission by ticket.)

British Institution of Radio Engineers

LONDON
"Time Sharing in On-Line Computer Applications," by A. St. Johnson. Computer Group. London School of Hygiene and Tropical Medicine, Keppel Street, WC1. Thurs., 3 Mar., 6.30 p.m.*

MANCHESTER
"Electronics in Oceanography," by M. J. Tucker. North Western Section. College of Technology, Sackville Street, Manchester. Thurs., 3 Mar., 6.30 p.m.

Chemical Society

OXFORD
"Chemical Engineering Aspects of Atomic Energy," by Professor P. V. Danckwerts. Oxford Branch. Inorganic Chemistry Laboratory, Oxford. Mon., 29 Feb., 8.15 p.m.

SALFORD
"Recent Developments in the Chemistry of Some Less Common Elements," by Professor R. S. Nyholm. Manchester Branch. Royal Technical College, Salford. Thurs., 3 Mar., 5 p.m.

Illuminating Engineering Society

EDINBURGH
"Design and Aiming of Area Floodlighting Installations," by G. K. Lambert. Edinburgh Centre. YMCA, 14 South St. Andrew Street, Edinburgh. Wed., 2 Mar., 6.15 p.m.

GLASGOW
"Design and Aiming of Area Floodlighting Installations," by G. K. Lambert. Glasgow Centre. British Lighting Council 29 St. Vincent Place, Glasgow. Thurs., 3 Mar., 6.30 p.m.

Institute of Fuel

SWANSEA
"Steam Utilisation," by D. P. Golch. South Wales Section. Offices of the South Wales Electricity Board, Kingsway, Swansea. Fri., 4 Mar., 6 p.m.

Institute of Petroleum

LONDON
"Corrosion Problems in the Lacq Field," by Michel Estavoyer. Wed., 2 Mar., 5.30 p.m.*

Institute of Physics

LONDON
"Role of the Mathematical Machines Laboratory of Imperial College in Education," by Dr. J. R. Barker. Accompanied by a visit to the laboratory. Education Branch. Imperial College of Science and Technology, Exhibition Road, South Kensington, SW7. Wed., 2 Mar., 5 p.m.

Institute of Refrigeration

LONDON
"European Refrigerated Transport by Railway," by Dr. E. Baumgartner. Institute of Marine Engineers, 76 Mark Lane, EC3. Thurs., 3 Mar., 5.30 p.m.*

Institution of Civil Engineers

LONDON
"Underground Station for Western District Post Office, London: Design and Control," by S. Blackford and E. W. Cuthbert; "Construction," by V. H. Collingridge and R. E. Tuckwell. Tues., 1 Mar., 5.30 p.m.*

Institution of Civil Engineers; Institution of Electrical Engineers; and Institution of Mechanical Engineers

LONDON
"The Engineer and Civilisation," by Sir Hugh Beaver. Sixth Graham Clark Lecture. Joint meeting of the three institutions. At the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, WC2. Thurs., 3 Mar., 5.30 p.m.

Institution of Electrical Engineers

LONDON
"Digital Computer Developments at Manchester University," by Dr. T. Kilburn; "A Digital Computer Store with Very Short Read Time," by Dr. T. Kilburn and Dr. R. L. Grimsdale; "High-Speed Light Output Signals from Electroluminescent Storage Systems," by Dr. G. R. Hoffman, D. H. Smith and D. C. Jeffreys; and "Ferrite Magnetic Core Memory Systems with Rapid Cycle Times," by Dr. D. B. G. Edwards, M. J. Lanigan and Dr. T. Kilburn. Measurement and Control Section. Tues., 1 Mar., 5.30 p.m.*
"Direct Writing Oscillographs." Discussion, opened by A. Smale and S. N. Pocock. Medical Electronics Discussion Group. Fri., 4 Mar., 6 p.m.*

LEEDS
"Transmission of News Film Over the Transatlantic Cable," by C. B. B. Wood and I. J. Shelley. North Midland Centre. Leeds and County Conservative Club, South Parade, Leeds 1. Tues., 1 Mar., 6.30 p.m.*

MANCHESTER
"Water-Turbine-Driven Induction Generators," by C. L. C. Allan. North Western Centre. Engineers' Club, Albert Square, Manchester. Tues., 1 Mar., 6.15 p.m.

Institution of Engineering Designers

BIRMINGHAM
"Plastics in Industry," by C. C. Morgan. Midlands Branch. Queen's Hotel, Birmingham. Wed., 2 Mar., 7 p.m.

Institution of Heating and Ventilating Engineers

LONDON
"Heat Requirements and 'Heating Effect'," by P. A. Coles. Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, SW1. Thurs., 3 Mar., 6 p.m.*

NOTTINGHAM
"Steam Storage Problems," by W. Goldstern. East Midland Branch. College of Arts and Crafts, Waverley Street, Nottingham. Wed., 2 Mar., 6.30 p.m.

Institution of Highway Engineers

LONDON
"New Methods of Automatic Traffic Control," by E. Bailey and E. Thorpe. Institution of Structural Engineers, 11 Upper Belgrave Street, SW1. Fri., 4 Mar., 5.30 p.m.*

Institution of Mechanical Engineers

LONDON
"Chemistry of Future High-Compression Engines," by Wheeler G. Lovell. James Clayton Lecture. Automobile Division. Tues., 1 Mar., 6 p.m.*
"Role of Formal Education and Training in Nuclear Power Developments." Nuclear Panel Discussion. Wed., 2 Mar., 6 p.m.*

GLASGOW
"Noise and Hearing: Physiological Aspects," by Professor William Burns; and "Origins of Diesel-Engine Noise," by A. E. Austen and T. Priede. Scottish Branch. Royal College of Science and Technology, Glasgow. Thurs., 3 Mar., 7.30 p.m.

SHEFFIELD
"High-Speed Precision Forging with Hydraulic Presses," by F. H. Towler and B. C. Wilkins. Yorkshire Branch. The University, St. George's Square, Sheffield. Wed., 2 Mar., 6.30 p.m.

Institution of Plant Engineers

LONDON
"The Deltic Locomotive," by C. M. Cock. Royal Society of Arts, John Adam Street, Adelphi, WC2. Tues., 1 Mar., 6.30 p.m.*

Institution of Production Engineers

CHELTENHAM
"Machine Tool Control," by O. S. Puckle. Gloucester Section. North Gloucestershire Technical College, The Woodlands, The Park, Cheltenham. Mon., 29 Feb., 7 p.m.

Junior Institution of Engineers

LONDON
"Windmills in Colour" (illustrated), by Rex Wailes. Fri., 4 Mar., 7 p.m.*

Liverpool Metallurgical Society

LIVERPOOL
"Semi-Conductors," by R. P. Chasmar. Department of Metallurgy, Liverpool University, 146 Brownlow Hill, Liverpool 3. Thurs., 3 Mar., 7 p.m.

Newcomen Society

LONDON
"Simon Goodrich and His Work as an Engineer, Part III, 1813-23," by A. S. Crosley. Wed., 2 Mar., 5.30 p.m.

Reinforced Concrete Association

LIVERPOOL
"Architectural Mannerisms in Reinforced Concrete," by S. G. Besant Roberts. North Western Branch. Liverpool Engineering Society, 9 The Temple, 24 Dale Street, Liverpool. Wed., 2 Mar., 6.30 p.m.*

MANCHESTER
"Architectural Mannerisms in Reinforced Concrete," by S. G. Besant Roberts. North Western Branch. College of Technology, Sackville Street, Manchester. Tues., 1 Mar., 6.45 p.m.*

Royal Aeronautical Society

LONDON
"British Research on the Aerodynamics of Powered Lift Systems," by Dr. J. Williams. Helicopter Section. Fri., 4 Mar., 6 p.m.*

Royal Meteorological Society

LONDON
"Weather, Soil and Plant Factors in Hydrology," by Dr. H. L. Penman. Wed., 2 Mar., 5.30 p.m.*
"British Rocket Programme." Joint discussion, organised in cooperation with the Royal Astronomical Society, Royal Society of Arts, John Adam Street, Adelphi, WC2. Fri., 4 Mar., 2.30 p.m. to 7 p.m.

Royal Society

LONDON
"Problems of Stellar Evolution." Discussion, opened by Professor F. Hoyle. Thurs., 3 Mar., 10.30 a.m.

Royal Society of Arts

LONDON
"Some Aspects of the Fuel Industries," by Dr. Albert Parker. Mon., 29 Feb., 6 p.m.

Sheffield Metallurgical Association

SHEFFIELD
"Cold Forging and Extrusion of Steel," by Dr. J. B. Hawkyard and N. S. Angus. BISRA Laboratories, Hoyle Street, Sheffield 3. Tues., 1 Mar., 7 p.m.

Society of Instrument Technology

FAWLEY
"Transistors as Applied to Control Equipment," by R. J. Miles. Fawley Section. Administration Building, Esso Refinery, Fawley. Fri., 4 Mar., 5.30 p.m.

SHEFFIELD
"Preventive Maintenance." Discussion introduced by E. Dowson, H. E. Farrar and M. Thomas. South Yorkshire Section. The University, St. George's Square, Sheffield 1. Wed., 2 Mar., 7 p.m.

Women's Engineering Society

MANCHESTER
"Cranecraft," by G. V. Sadler. Manchester Branch. Manchester Society of Chartered Accountants, 46 Fountain Street, Manchester 2. Thurs., 3 Mar., 6.45 p.m. (approx.).

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. An asterisk (*) is placed where it is understood that refreshments are available prior to the time stated.

Aslib (Association of Special Libraries and Information Bureaux), 3 Belgrave Square, London, SW1. (BELgravia 5050)
Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham 2. (Midland 1914)
British Institution of Radio Engineers, 9 Bedford Square, London, WC1. (MUSeum 1901)
Chemical Society, Burlington House, Piccadilly, London, W1. (REGent 0675)
Illuminating Engineering Society, 32 Victoria Street, London, SW1. (ABBey 5215)
Institute of Fuel, 18 Devonshire Street, Portland Place, London, W1. (LANgham 7124)
Institute of Petroleum, 61 New Cavendish Street, London, W1. (LANgham 3583)
Institute of Physics, 47 Belgrave Square, London, SW1. (BELgravia 6111)
Institute of Refrigeration, New Bridge Street House, New Bridge Street, London, EC4. (CENtral 4694)
Institution of Civil Engineers, Great George Street, London, SW1. (WHItehall 4577)
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. (COVent Garden 1871)
Institution of Engineering Designers, 38 Portland Place, London, W1. (LANgham 8847)
Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London, SW1. (SLOane 3158)
Institution of Highway Engineers, 47 Victoria Street, London, SW1. (ABBey 3891)
Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. (WHItehall 7476)
Institution of Plant Engineers, 2 Grosvenor Gardens, London, SW1. (SLOane 0469)
Institution of Production Engineers, 10 Chesterfield Street, London, W1. (GROsvenor 5254)
Junior Institution of Engineers, Pepys House, 14 Rochester Row, London, SW1. (VICtoria 0786)
Liverpool Metallurgical Society, Greenhithe, Grosvenor Road, St. Helens, Lancs. (St. Helens 5879)
Newcomen Society, Science Museum, Exhibition Road, London, SW7. (KENsington 1793)
Reinforced Concrete Association, 94-98 Petty France, London, SW1. (ABBey 4504)
Royal Aeronautical Society, 4 Hamilton Place, London, W1. (GROsvenor 3515)
Royal Meteorological Society, 49 Cromwell Road, South Kensington, London, SW7. (KENsington 0730)
Royal Society, Burlington House, Piccadilly, London, W1. (REGent 3335)
Royal Society of Arts, John Adam Street, Adelphi, London, WC2. (TRAfalgar 2366)
Sheffield Metallurgical Association, 64 Crescent Road, Sheffield 7. (Sheffield 52865)
Society of Instrument Technology, 20 Queen Anne Street, London, W1. (LANgham 4251)
Women's Engineering Society, 25 Foubert's Place, London, W1. (GERrard 5212)

Rock Failures at Low Confining Pressures

By Professor J. C. Jaeger

Australian National University, Canberra

Triaxial tests throw light on the criterion of failure of rocks. Fundamentally failure occurs by slip on a single shear plane even at low confining pressures. Failure may take other forms, such as slabbing with tension cracks, according to supporting conditions.

Procter[1] has recently reproduced a number of figures, both from the old and newer literature, illustrating various types of failure of concrete and rocks in unconfined compression. In the past, the breakdown of specimens to leave two conical end pieces on the platens was regarded as the normal type of failure, but more recently the tendency of test pieces to break up into vertical slabs has been emphasised, cf. Talobre.[2]

In the past few years a great deal of attention has been paid to the triaxial testing of rocks, though mostly at relatively high confining pressures for the study of the brittle-ductile transition region. The United States Bureau of Reclamation,[3] working at confining pressures of approximately 0, 500, 1,000, . . . 2,500 lb per sq. in, usually found vertical fractures at zero confining pressure with a tendency to shear failure across a single plane as the confining pressure is increased. Paterson,[4] using Wombeyan marble, found vertical fractures at zero confining pressure, but a single shear plane at 500 lb per sq. in. Bredthauer,[5] Robertson[6] and Handin and Hager[7] worked at still higher confining pressures at which they usually observed fracture in a single plane (or, for some materials, ductility) but they also made experiments at zero confining pressure and reported splitting into vertical slabs or into many pieces. Thus there is now in the literature a definite suggestion that at confining pressures of a few thousand lb per sq. in the normal method of failure of a rock in axial compression is across a single shear plane which makes an angle of less than 45° with the greatest compression, but at zero confining pressure the method of failure is by splitting into slabs by planes parallel to the compression. There is implicit in this a suggestion that different mechanisms of failure may operate in the two cases; for example, that failure in uniaxial compression might be due to tensile stresses (as in the case of a cylinder compressed by forces in a diametral plane).

In order to investigate this question a number of experiments has been made on a variety of rock types at low confining pressures ranging from 0 to 3,000 lb per sq. in. The apparatus used has been a slight modification of the small triaxial rig of the United States Bureau of Reclamation, using rock cylinders 2 in in diameter and 4½ in or 5 in long. The lower end of the specimen rests on a spherical seat and the importance of this for studying initial failures must be stressed, since, if the initial failure takes place across a plane, rotation of the seat will tend to confirm motion across this plane while secondary effects might be introduced by an immovable seat. The materials used included Wombeyan marble, Wells limestone, Hawkesbury sandstone, a granitic gneiss, a coarse grained rock described as "porphyry" which might possibly be a welded tuff, and a 2 : 1 cement mortar.

Experiments were made at a range of confining pressures between 0 and 3,000 lb per sq. in with special attention to the low values, 0, 50, 100, 200, 300. The stress-difference necessary to cause failure is shown in Fig. 1 as a function of the confining pressure for various materials, and it is seen that in all cases it varies continuously with the confining pressure down to zero pressure. This suggests that the same mechanism and criterion of failure operates at zero confining pressure as at the higher pressures.

It was also found that the type of failure across a single inclined shear plane observed at higher confining pressures persisted down to confining pressures as low as 100 or even 50 lb per sq. in, provided the test was conducted slowly over the last stages. In many cases it was possible to stop the test before complete failure had taken place, but so that on removal of the specimen a diagonal crack showed faintly on the surface of the specimen. Fig. 2 shows a number of shear failures in various materials at a confining pressure of 100 lb per sq. in.

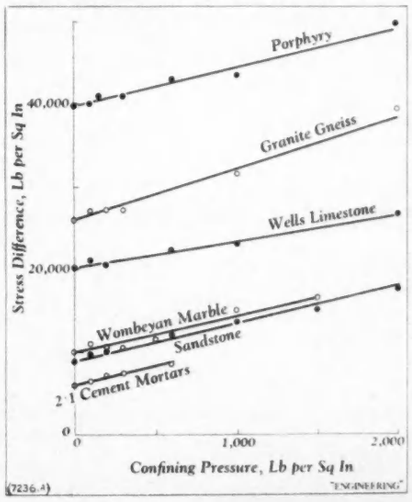


Fig. 1 The stress-difference necessary to cause failure as a function of confining pressure for various materials. Each point is the mean of three or more results.

The fact that the method of, and numerical values for, failure extend in this way down to confining pressures of 100 or even 50 lb per sq. in suggests that failure may begin in all cases by shearing near the centre of the cylinder and that the vertical slabbing and cracking observed in unconfined compression may be due to secondary effects. One way in which these occur may be seen from Fig. 3. Fig. 3 (*b*) shows vertical cracking in a specimen of the (rather hard) Wells limestone. If this specimen is now dissected by removing the vertical slabs a structure similar to Fig. 3 (*c*) is revealed. The form of this is approximately a conoid (a surface ruled by lines perpendicular to a diameter and passing through the circular ends of the cylinder). This suggests that the initial failure was in a plane through the diameter already mentioned, and that this caused rotation of the spherical seat, which, in the absence of any confining pressure, caused the vertical slabs to be pushed out. An incipient phase of this tendency of the fracture to depart from a plane and run around the edge of the specimen appears in Fig. 2 (*b*).

A very wide range of secondary effects, depending on the nature of the rock and the method of support, may be expected. One typical example involving the rather brittle Wells limestone is shown in Fig. 3 (*a*). In this case the spherical seat (at the bottom of the specimen but uppermost in the illustration) rotated suddenly on failure; the material to the left was broken up and thrown out violently, a tension crack (upper right) formed; and the wedge-shaped upper portion was forced into the lower, forming vertical tension cracks (not seen in the illustration). Behaviour similar to this on a larger scale occurs in the slabbing of vertical faces in mines.

In testing specimens between rigid platens rather different conditions develop as one single shear plane is not favoured. In some cases

Continued on next page

Fig. 2 Shear failures at 100 lb per sq. in confining pressure. The specimens, reading from left to right, are (a) Wombeyan marble, (b) Sandstone, (c) Granitic gneiss, (d) "Porphyry," (e) 2 : 1 cement mortar.

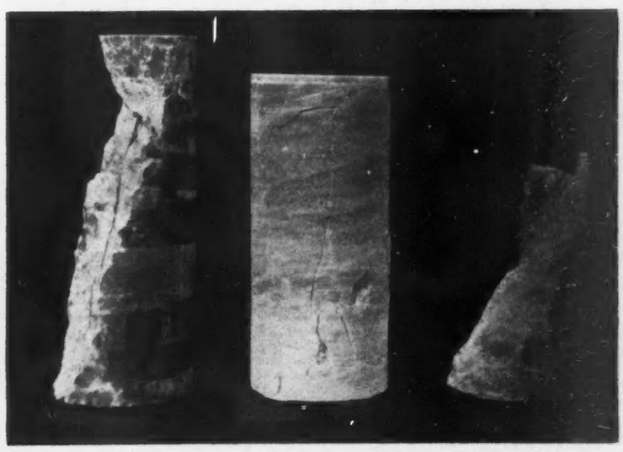
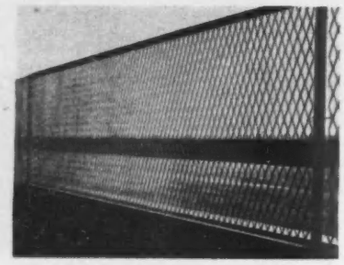


Fig. 3 Types of failure in unconfined compression with specimens supported on a spherical seat. Reading from left to right, the specimens are (a) Wells limestone, showing explosive slabbing, (b) Wells limestone, showing vertical cracking, (c) Wombeyan marble, dissected by removing slabbed material to show conoidal fracture.

Anti-Dazzle Screen on Motorway

An experimental two-mile length of anti-dazzle fencing has been erected along the central reservation of the M1 motorway. The screen, which is shown in the illustration, consists of expanded metal panels of galvanised hot-spelter steel carried on tubular steel posts set in concrete at 10 ft centres. The site of the



Expanded metal anti-dazzle screen on the London-Birmingham motorway.

experiment is between Chalton Cross, Bedfordshire, and the Dunstable road junction near Luton.

Advantages claimed for the design are a long life without attention; a low capital cost; and easy replacement in the event of damage (each panel is held only by four bolts). It also has the advantage over a vegetation screen that it is fully operational as soon as it is erected, whereas shrubs take some time to become established. It is also the better crash barrier. The design was evolved after a series of tests by the Road Research Laboratory using a variety of meshes supplied by the Expanded Metal Company, London, SW1.

The argument for screening as opposed to lighting is that the latter would have to be superlative—and consequently very expensive—if it was to be good enough for the motorway, whereas the screening is said to be relatively cheap. It is also suggested that the majority of motorists would prefer to use their headlights rather than rely on general road lighting.

Concluding **Rock Failures**

movement takes place along two conjugate planes: this has been observed by Paterson[6] in marble. More frequently, however, following initial movement on one plane, subsidiary failures take place across several conjugate planes. In many cases an approximately conical end member of the classical form remains instead of the conoid of Fig. 3 (*c*).

Finally, it must be mentioned that behaviour differs considerably among rocks. In some materials—marble, sandstone and cement—it was usually possible to stop testing before any important secondary effects had developed. In others, such as dolerite and granitic gneiss, a well-defined shear plane usually was formed even though complete and sudden failure had occurred. Secondary effects were very frequently observed with Wells limestone and "porphyry," probably for different reasons. The Wells limestone frequently showed a number of fine fractures, often almost conchoidal, which suggested the effect of shock waves from the original sudden failure; in the porphyry, secondary fractures probably began at the large quartz grains which would effectively prevent much movement on one shear plane.

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Pahlavi Bridge Opened

The Pahlavi Foundation bridge, which spans the River Karun to link the island of Abadan with the port of Khorramshahr in southern Persia, was opened by the Shah on 1 March. The bridge was designed and built by the Cementation Group of Companies of London.

The bridge has an overall length of 2,000 ft with five river spans together totalling 828 ft; the full width of the roadway and the cantilever walkways is 34 ft, with 24 ft 6 in between kerbs. Allowances were made in the design for the heaviest traffic.

Precast concrete piles were driven from floating craft through the soft silt and sand to the hard rock 65 ft below the river bed. The piers were built inside steel shuttering so as to obtain the best outside finish. The steel superstructure was fabricated by Braithwaite and Company Limited of London and shipped out in 17 metre lengths. The main spans of 50 to 60 m were assembled and either floated or rolled into position. The deck is of concrete.

Construction was begun in September, 1958, and completed in January this year after only 16 months and eight months ahead of schedule.

Progress at Snowy Mountains

Another stage was completed earlier this month in the Snowy Mountain hydroelectric scheme, with the pouring of the last concrete for the Tantangara dam on the headwaters of the Murrumbidgee River. The tunnel will serve to divert the river through a tunnel 10½ miles long. The contractors for the dam are Uta (Australia) Limited and Brown and Root (Sudamericana) Limited. Output from the two stations at Tumut will be increased by 25 per cent with the completion of the dam.

Replying on behalf of the guests at the annual dinner of the Association of Consulting Engineers, Sir Eric Harrison, the High Commissioner for Australia, pointed out that there was still an immense amount of work to be done on the scheme—a figure of £400 million was mentioned. So far there had been hardly any tenders for the work submitted by firms in Britain. There was, he said, a wonderful opportunity for both consulting engineers and contractors in Australia.

Wood Hardener for Concrete Formwork

Work on the manufacture of the precast concrete piles for the Avonmouth Docks Improvement Scheme is being materially assisted by the use of a new synthetic resinous agent designed to surface-harden the timber shuttering. Known as "Moldcote" the hardener imparts a smooth impermeable gloss finish to the wood and so helps to give a fine even surface texture to the concrete as well as enabling a considerable increase in the number of uses obtained from the shuttering.

The contractors at Avonmouth are John Laing and Son Limited. About 1,000 piles, averaging 65 ft in length, will be required. Work began at the beginning of this year and is due for completion about mid-1963. Suppliers of the Moldcote are the Laing subsidiary, John B. Dickens of Victoria Street, London, SW1.

Lining for Irrigation Trenches

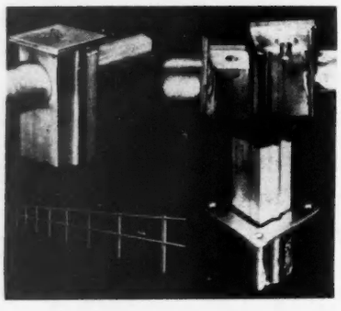
Reports from the USA describe a lining made of 15 oz burlap coated with asphalt for use in irrigation trenches. The thickness of the lining is only ⅜ in. Preliminary treatment of the burlap prevents rotting. Joints in the lining can be flash welded using a liquid-petroleum torch. After laying the asphalt-impregnated burlap, it is sprayed with a clay emulsion to inhibit deterioration of the asphalt.

It is only just being appreciated what can be done by systematic irrigation in countries with temperate climates, such as our own, where cultivation is exceedingly intense.

Light-Alloy Handrails for Harbour

Aluminium alloy handrails have been used at the new port of Tema in Ghana. The rails were specially designed for quick removal and interchange of position by Birmetals Limited, of Quinton, Birmingham. Birmabright BB2 alloy has been used throughout and argon welded into 12 ft sections.

The prime reason for the choice of an aluminium alloy was its resistance to corrosion



Aluminium handrails for the Port of Tema in Ghana.

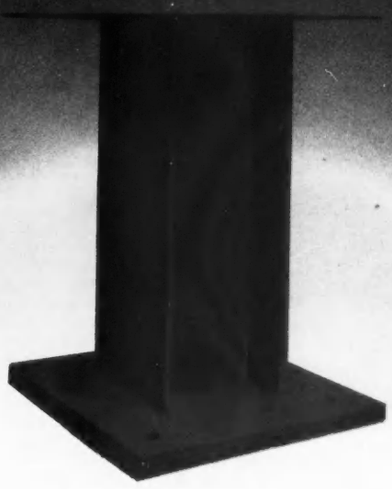
by sea-water and salt-laden spray without the need for painting or other treatment.

The top rails are 3 ft 5½ in above a wooden kerb and the rails are 18 in apart. Each section is married to the next by inserting the uprights into sockets, coupling the two end posts by a top peg and with the side flanges of the posts overlapping.

Estimated to cost £18 million, the port of Tema is expected to come into commercial use early this year. It has eight berths to handle up to 2 million tons of freight each year. The consulting civil engineers for the project are Sir William Halcrow and Partners, and the main contractors Parkinson Howard Limited of London.

Aluminium Displaces Galvanised Steel

An American manufacturer of domestic piping and ductwork is changing over from galvanised steel to aluminium sheet. The firm concerned is the Maxwell Steel division of Creamer Industries, Inc., who say that they are making the change because they can make a more attractive line in aluminium and because the light metal is now competitive in price with other materials. Maxwell will be using Reynolds aluminium sheeting and initial production schedules call for a "substantial tonnage" monthly. Reynolds also point out that the aluminium ducts will deliver 15 per cent more heat than steel because of the former's low emissivity.



...no rivets?

There aren't so many rivets in to-day's steelwork, because Britain's steel industry is now rolling new beams and columns, so proportioned as to carry the load without needing riveted-on plates. Welding also reduces the amount of riveting, and results in a neat, compact construction.

CHEAPER

These advances mean that the finished structure is cheaper, because steel and labour are saved.

STRONGER A higher safe working stress is now recognized, again reducing the amount of steel needed for a given job.

FURTHER SAVINGS Fire-proof encasement, hitherto calculated as a burden on the steelwork, is now accepted as contributing to its strength: so that columns can be slimmer, saving steel and labour.

STEEL FOR STRENGTH SECURITY

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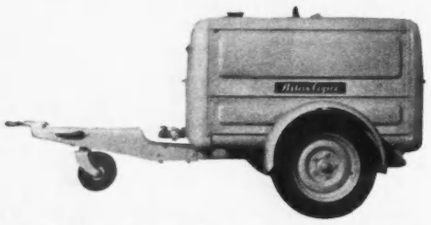
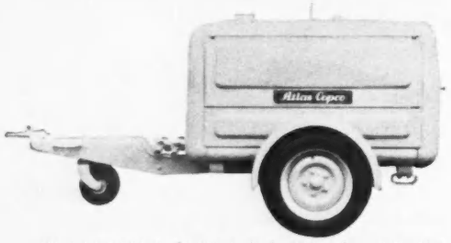
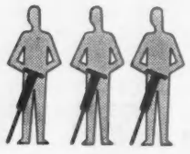


Weight 2,180 lb (990 kg) ★ 115 c.f.m. 3.2m³/m

VT4



Weight 2,310 lb (1,050 kg) ★ 160 c.f.m. 4.5m³/m



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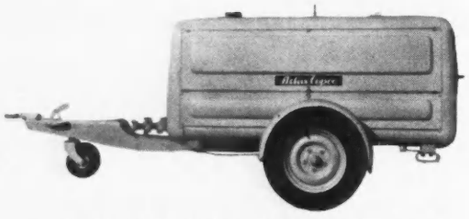
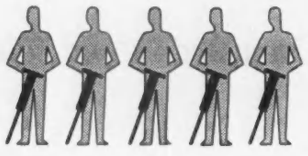
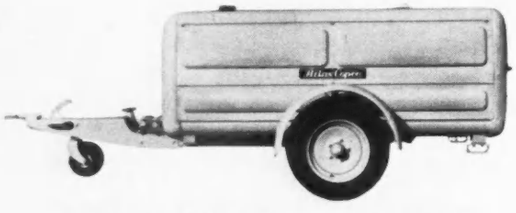


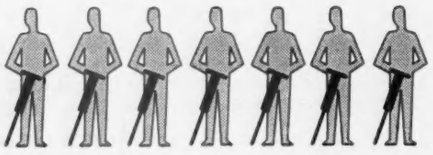
Weight 2,900 lb (1,315 kg) ★ 225 c.f.m. 6.4m³/m



VT6



Weight 3,590 lb (1,630 kg) ★ 315 c.f.m. 8.9m³/m



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P.C.11

Human Element

Rail Pay Side Effects

The railwaymen's 5 per cent is indeed only a holding award. The fuller effect of the Guillebaud report on the Transport Commission's deficiencies is to be something much nearer to £50 million than £19 million for the all-round 1*s* in the £1.

And that is by no means all, for though the rail unions have, unlike the engineering unions, put pay before hours, a claim from the three rail unions for a shorter working week will be put to the BTC in the same week that the Guillebaud survey is handed down. The NUR and the footplate crews' union will be asking for their week to be reduced from 44 to 40. The clerks—the Transport Salaried Staffs Association—are mostly now on a 42 hour week and they want to come down to 38.

On top of the probable Guillebaud £50 million the cost in the unlikely event of these claims being conceded would be up to £25 million in a full year. But there is only so much force of discontent to go round at any one time and there hardly seems to be a serious prospect of trouble if the hours claim is rejected as it makes its way through the negotiating machinery.

But it is further evidence that even workers in a dispirited concern, such as the railways have been allowed to become, have their aspirations. If they are not to be met there will be one more incentive for men of spirit and ability to leave and do better outside.

Shorter Hours for the Civil Service?

Is the movement towards shorter hours in industry to spark off a claim for a reduction in the hours of Civil Servants? That the inter-related wages and hours situation of the electricity supply industry, the engineers and shipyard workers, the building workers and the men in the gas industry is being closely watched by the representatives of some Civil Servants is made clear in the February issue of *State Service*, the journal of the Institution of Professional Civil Servants.

"Any general movement towards a reduction of working hours" will be expected by the Institution "to be reflected in the Civil Service," says the leading article.

It goes on to urge the National Staff Side (of the negotiating machinery for the Civil Service) to consider whether the time has not come for a claim for a shorter working week to be submitted.

Mr. Stanley Mayne, general secretary of the Institution, also writing in *State Service*, is disturbed that no arrangements are being made, apart from those of the Post Office, he alleges, to build up proper servicing machines for automatic data processing machines in use in the Civil Service. He also sees problems growing up over shift work on these machines. Shift working has been done for some time past at Risley, the industrial group of the United Kingdom Atomic Energy Authority. Mr. Mayne doubts if it will be possible to overcome staffing difficulties.

Too little attention is, he says, being given to noise problems. On both these questions the staff representatives are proposing that the "official side" should give a lead.

So Much for Sly Asides

When the Trades Union Congress gave up the unequal struggle to examine the inner workings of the Electrical Trades Union it did so with a hint to the union's members that they knew what to do when the elections came round.

Well the election for the general secretaryship, held by the Communist party executive member Mr. Frank Haxell, came round. And now Mr. Haxell is still there sitting in his high seat, officially declared re-elected by the union's executive committee. Mr. Frank Foulkes, the Communist president of the union was re-elected late last year.

The curious thing to observe in this long drawn out row is that Mr. Foulkes has quietly taken his place as leader for the year of the important Confederation of Shipbuilding and Engineering Unions; that the allegations are now almost always of procedural improprieties, and that it is very hard indeed to find criticism of the way in which Mr. Foulkes, Mr. Haxell, and their executive colleagues go about the job they are voted in to do; that of representing the membership in negogiations.

Affairs of this nature, and this is perhaps the most serious that there has been for side-effects on the public esteem of the unions, generate a speed and pace of their own. The ETU's internal affairs, no longer capable of being confined within union boundaries, came up again in the House of Commons and the Prime Minister let fall the intriguing observation that the report of the Trades Union Congress was "rather a long time ahead."

Whether in Africa, Moscow or Westminster, Mr. Macmillan is not a man whose lightest word can ever be safely overlooked. And this may not be light at all.

If it is rather a long time to await the TUC's words, and they are not the same as something being done to clear up a situation that does neither the union nor its members any good, then perhaps the Prime Minister has something speedier in mind.

He turned down the request of a Conservative member for the appointment of a tribunal to inquire into the administration of the union and allegations of malpractices. This, said Mr. Macmillan, was not necessarily the appropriate action at this stage.

Under the Electrical Trades Union rules if the members of a small number of the 675 branches ask for an inquiry then it must be held, but if half the allegations that are made are true nothing should be hoped for in that direction. The Trades Union Congress, which broke off its attempt at investigation as "abortive" received the tongue-in-cheek proposal from the ETU leaders that they would consider taking legal action against their traducers if the TUC would guarantee the costs whatever the outcome.

It could be that these allegations and counter allegations will yet end up in a court of law. Mr. Foulkes has now said in a TV interview: "I am quite well able to stand up to any charge of criminal conspiracy."

Fixing Labour's Future

The battle now raging in the Labour Party is of importance outside the ranks of those engrossed in their campaigns. The successive engagements and the tactics of this group and that will inescapably influence the policy and the political possibilities of the eventual victor.

If Mr. Gaitskell tires of the unrewarding struggle and resigns so much will depend on which of the aspirant hopefuls succeeds, if that is the word, that it cannot be said with certainty how the present exchanges would affect his proposals and through them the country.

Mr. Gaitskell has established a convincing image as an election loser but perhaps has fewer enemies than any one of the rivals. Should he ride out the discontents until it is too near the next election to risk a change, he is already making statements that are full of direct consequence for industry.

Mr. Harold Wilson, who might be Chancellor of the Exchequer in a Labour administration, has now come out against Mr. Gaitskell's suggested revision of Clause Four—the public ownership article in the Labour Party's constitution. Mr. Wilson declared that it was not Clause Four that their opponents seized on during the election campaign but rather the Party's references to the "600 major companies," which Mr. Wilson now describes as a "highly sophisticated essay in modernisation."

Mr. Gaitskell sooner or later has to react to this sort of thing. His reaction came at Nottingham and his prescription now, whatever he said at Blackpool, is for more public ownership, certainly in steel, road transport and water supplies and "quite probably . . . in other fields as well."

The Labour Party leader suggesten political movement in another directioa when he said it was absurd to expect d solution to the current town and country planning crisis without more "public enterprise." Since it is a government decision that has allowed the American distant early warning radar device into a National Park it is not easy to see the reasoning in this but, quite specifically, it is one more field where Mr. Gaitskell is committing himself to further public, that is to say, government or nationalised board, activity.

Shorter Hours Spur to Management

The movement towards the shorter working week has reached the engineering industries. After the example of chemicals, electricity supply and many others, the Engineering and Allied Employers' National Federation have been told by the union leaders that they accept their offer of a cut in the working week from 44 to 42 hours. There is a disagreement over what this will cost the industries, but the employers' view is that the bill will not be under £100 million a year.

The reduction, the first since 1947, will take place on March 28 and will affect some three million workers.

The decision by the leaders of the Confederation of Shipbuilding and Engineering Unions to let the wage claim go for the time being is a victory for the determined leadership of Mr. William Carron, president of the Amalgamated Engineering Union and the most powerful single voice in the Confederation's meetings at York. Back in the summer the rank and file representatives at the union's conference had laid great stress on going for a wage increase as well. Mr. Carron has never wavered in his arguments, within the union and outside, that the first target should be the shorter working week.

A 42-hour week is an important step on the road to the 40-hour week. How close that may be is revealed in the reports of an employers offer that if no wage claim were made for two years the two hour reduction should then be conceded. This the unions turned down and it is difficult to see how, if they had not, they would have been able successfully to go on containing their militant forces.

For the firms with long order books the extra overtime can more easily be carried. The firm that for the time being is not so prosperous will not have the overtime to be worked anyway. This is a solution to the situation which will sharpen the appetite of the worker to work for the most successful business.

And that will be a useful spur to management.

The same cannot be said in the shipyards, where overtime is for very many people no more than a memory. The unions have indicated they will accept a 42 hour week and no pay increase from the Shipbuilding Employers' Federation subject to an agreement being reached over piece workers' pay rates. The vital point here will lie in the extent to which the shipyard boilermakers, welders and others can bring themselves to adopt the utmost modernisation.

Libel Writ against Shop Steward

Long after the uproar over the Electrical Trades Union recedes into oblivion the action of the Birmingham motor component makers, Hardy Spicer Limited, in issuing a writ for libel against one of their shop stewards may stand as a milestone in industrial relations.

Protected, partly by a public opinion which remembered the once impotent position of the worker, from the consequences of their actions in starting costly strikes, shop stewards and some union executives have had an appearance of being above the law.

Probably the only way in which the assembly lines of the British Motor Corporation can be wilfully stopped against the wishes of the management without somebody being legally liable is the strike action of the employees.

Now Hardy Spicer, libelled, they allege, in notices put up in the works by Mr. Frank Troth, a night shift grinder regarded by his colleagues as the chief shop steward, have taken a step which must be closely watched by every employer and trade union official.

The long term effects may now be incalculable. What is certain is that, as the firm make nine out of ten propeller shafts used in British vehicles, the strike of its 2,000 men over the sacking of Troth threatens to close down every major car firm in the UK.

Cashing in on World Loans

More and more the Western and the Communist nations are aware of the need to help the poor countries towards the point where they start helping themselves. Investing abroad gives more work to our own industries. Which branches of engineering will benefit?

A hundred years ago mechanical and civil engineering skill aided by Victorian thrift was opening up the railway systems of the world. It was largely British enterprise and Irish brawn which provided the human ingredients. And so the great age of the railways and British overseas investment began. Signs are not lacking that a similar burst of overseas investment is scheduled for the 1960's. This time the figures may be much bigger, even when allowance is made for the lower purchasing power of money today.

In the context of expanding overseas investment the start of the 1960's is significant for a number of reasons. The first is the realisation by the industrialised West that the underdeveloped areas of the world will be won for the West rather than for the East (in the sense of the Communist countries) only if the western democracies can be seen to be helping to raise the standard of living in such areas. Until recently, this was a thesis only partially popular in this country and the United States. Now all the West accepts it. Indeed some of its implications have been written into the Treaty of Rome which established the European Common Market. Secondly, Europe is now willing, at least in some degree, to take some of the burden of helping to finance world foreign investment whereas till recently only the United States, aided sporadically by this country, took the strain—on its balance of payments.

ACCEPT THEIR GOODS?

There exists now the will to invest abroad, the funds (at least to a significant extent) and the machinery. Only one vital problem remains as yet unresolved for the new decade and that is the issue of trade as well as aid. Will the western democracies accept goods from the underdeveloped countries to pay for the aid (not always given as a gift) once these countries have become partially industrialised.

So far as the machinery of international investment is concerned there is a wealth of outlets by yesterday's standards. For those who like such figures there are 43 major foreign investment and credit agencies at work in the western world, ranging from the World Bank to say the New Zealand Credit Export Scheme. In terms of size, however, and scope of activities the biggest are the World Bank, the Export-Import Bank of Washington, the Colombo Plan, the International Finance Corporation (an affiliate of the World Bank), the Colonial Development and Welfare Grants (UK overseas dependencies only) and the European Economic Community Development Fund. The International Monetary Fund and the European Investment Bank (a creation, this last, of the European Common Market) are excluded because the aid they give is of a special kind connected with problems of national balance of payments and not with long term investment.

These organisations, and similar smaller ones, do not exhaust the list. The Communist countries have their own organisations such as the Council for Mutual Economic Aid (Comecon) and there are two other major types of overseas investment. These are, first, government guarantees or some similar form of help which comes out in, say, Britain, making special arrangements for India's credit to build a steel works or Russia erecting the new Aswan Dam on certain credit terms. There is also the huge flow of private investment in the western world which can be neither estimated in size nor the main direction of its flow ascertained.

All these types of organisation, excluding those operating under non-government auspices in any form, are concerned in advancing money in backward areas by assessing projects, and sometimes sending technologists as a form of aid as well as money, according to certain clearly defined criteria. They are as it were permuting a number of factors among which the chief are: chance of a scheme surviving economically, credit of a government, degree of risk, kind of local guarantees available, degree of local participation forthcoming either official or non-official in money and men, place of a scheme in a wider plan of development, varying rate of interest or free gift and the form in which security should be held if at all. All these issues are examined before a loan is granted by the major world financing organisations.

Much time has been spent in the 1950's in finding out how to assess schemes in the face of local over-optimism and in persuading potential recipients of funds that they must be willing to learn not only new technologies but also how to spend big sums of money on capital projects and how to run those projects economically once they have been completed.

No statistics have ever been brought together to show how much is invested abroad by lending countries or for what purpose it is used, nor are there likely to be any such figures for a long time. The only systematic and regular figures of overseas investment which are available for any recent period are those put out by the World Bank. They are not a statistical sample of what the pattern of investment is in a global sense but they may be considered as reasonably indicative.

Up to June, 1959, the International Bank for Reconstruction and Development had made loans of $4,426 million, of which $3,929 million were development loans. Of this last figure Asia had had $1,297 million, the western hemisphere $934 million, Europe $791 million, Africa $589 million and Australia $318 million. The tendency has lately been for Europe to have less and for Asia and the western hemisphere, mainly South America, to have more.

THE COMMONWEALTH

This does not mean that the total amount of investment generated as a result of these loans has necessarily been of the same descending order of magnitude for the different areas. Broadly speaking, European countries and those countries with a large European element such as certain parts of the British Commonwealth have generated more investment round these loans than have others. That has been because such areas have means of mobilising local capital and have some conception of the importance of thrift. In these places local participation in schemes so far as finance is concerned has been a significant factor. For example, it is easier for the World Bank to insist on local financial participation in a project in South Africa or the Rhodesias than in say Brazil or India.

When the Colonial Development and Welfare funds were being allocated immediately after the war and British colonies were encouraged to put together plans into which these funds would fit, they were encouraged to think in terms of basing a higher standard of living (apart from direct welfare expenditure) on more and cheaper electric power, better water and improved communications. It is interesting that the World Bank has produced a not dissimilar pattern in a slightly wider context.

By far the largest amount of capital from the World Bank has gone into electric power generation and distribution and into better communications. About one third of the total has been used on power—especially in Asia and South America. The amount spent on transportation has been only slightly smaller. Railways have accounted for easily the largest amount, and most of this has been spent in Asia and Africa. One of the big achievements of the Bank has been to father a scheme by which the Indian railways have been put on a really solvent, progressive basis. In the western hemisphere the development of road systems has played as big a part as improved rail facilities.

Rather less than 10 per cent of all development loans have gone into agriculture. The main outlets here have been farm mechanisation in Australia and flood control and land irrigation in Europe. Africa has so far received nothing under this heading.

Industry accounts for rather less than 20 per cent. The really big items here have been the iron and steel industries of Asia, the latest to benefit being Japan.

UPWARD SPIRAL

These overall figures should not however hide the diversity of operations being undertaken by the World Bank, the activities of other international organisations nor the enormity of the investment problem which still has to be solved to generate an upward spiral in world living standards. Since June, 1959, the Bank's loans have included $9 million advanced to Austria for private industry to modernise its plant and equipment, a further $44 million for the iron and steel industries of Japan, and $5 million to the Industrial and Mining Development Bank of Iran (IMDBI) which has been formed by private investors from Iran, the United States, the United Kingdom, France, Belgium, Germany, Holland and Italy.

Other organisations have not been idle. The Export-Import Bank advanced credit at the beginning of November for the Italian SELNI atomic power station project which is scheduled to go critical in four years' time.

To indicate the size of the problem remaining to be solved, attention is drawn to the loan approved by the World Bank for Pakistan last September for $10 million for the Pakistan Industrial Credit and Investment Corporation, which is to be used to meet the corporation's foreign exchange requirements. In November Pakistan announced that it will need $350 million of foreign aid annually to meet its second five year plan to be launched in June, 1960.

The benefit for the various branches of the UK engineering industries of these high rates of world investment has been considerable. The high level of overseas civil engineering contracts now achieved by this country (despite the recession new ones have been coming in at the rate of about £100 million a year and are likely to go higher in 1960) owes much to the impetus of organised international investment. There have also been substantial orders for UK industry arising out of it. Mr. Eugene R. Black, President of the Bank, has estimated that since it had started operations British industry had received orders worth £140 million, or 50 per cent more than the total paid in to the Bank's capital by the British Government. These are substantial benefits.

And the future? The future of international investment looks healthy. There are sound political and economic reasons for thinking that apart from such delays (and they are likely to be only delays) which a world economic recession might bring, international investment especially in Asia, Africa and South America is likely to go on increasing. There will however be a change of emphasis. There will probably be less for railways and more for roads. There will be more for electric power, large as the figures already are. Industry will certainly take much more and the amount going to agriculture will increase.

In the past the civil engineer has had the big advantages from the renewed flow of money over national frontiers. The happy position is likely to be reached where he will not get less, but other engineers will get more—provided UK industry remains competitive in its prices.

Engineer Training in the New Nations

As the once backward territories become independent and develop they are not content to take their corporate engineers solely from more advanced countries. Acute problems are generated, both of syllabus and status, as new centres of education spring up.

By J. B. Hunt, M.Eng., B.Sc. (Eng.), A.M.I.Mech.E.
University of Southampton

In recent months a lively interest has been shown in the respective merits of the undergraduate training of engineers in Britain, the USA, USSR and other advanced countries. Engineering training in underdeveloped countries is also of great importance both to the countries concerned and to the well developed countries which will supply the capital equipment required for this development. A large proportion of the territories concerned lie within the tropics. A number of these territories are now independent States and it is natural that they wish to replace their expatriate engineers with qualified nationals as soon as may be. Generally all senior engineering positions in the railways, roads, airways, harbours, power supply, telecommunications and in the commercial import-export agencies are held by expatriate engineers, or have been until very recently.

The engineer must be capable of maintaining equipment, modifying equipment to suit local usage, estimating future requirements and planning accordingly, writing specifications for overseas suppliers, selecting tenders and sifting the recommendations of consultants. He must be able to direct and supervise the activities of subordinates who may be products of a technical school. The engineer would not be required to carry out original research or design in his early years. This may come later for those engaged in the development of their country's particular local industry, whether it be rubber, cotton, cocoa, bananas or hydroelectric power. The graduate engineer should accordingly be well versed in general civil, mechanical or electrical engineering without emphasis on any part of these main divisions.

GENERAL PRINCIPLE

The undergraduate engineer would therefore require a thorough grounding in the theory and design of structures, strength and elasticity of materials, soil mechanics and geology, surveying and fluid mechanics for the civil student; the theory and design of machines, strength and elasticity of materials, thermodynamics and hydraulic machinery for the mechanical student; electrical power, electrical measurements, electronics and telecommunications for the electrical student. The student would then graduate in one of these three main divisions. The prospective engineer would not be required to specialise, or read for honours, in particular subjects. There are two main reasons for this.

An underdeveloped country needs in the first instance large numbers of general engineers to get the industrialisation of the country under way. Instruction in specialised subjects requires expensive laboratory and field equipment and expatriate staff highly qualified in that subject. In overseas colleges and universities the turnover of staff is high, so that a staff member must be prepared to teach any subject in his main division. A " one-subject" specialist would be an extravagance in such circumstances. As a general principle it is suggested that a student should receive such a general engineering education as described above and that, on graduation, he should be employed for two or three years in his native country, gaining as wide a practical experience as possible in engineering departments.

He would then be able to decide on a particular field, which might be in railways, public works, power stations, oil or local factory industry. If a man then chooses to work in the industry which produces the country's highest currency-earning commodity, his employers may decide to send him abroad for further practical and theoretical instruction for one or two years. In a country of no engineering tradition, where many students read engineering because they cannot find a place in the faculties of medicine or law, this principle will produce more satisfactory results than the system in which money is lavished on specialised courses.

SYLLABUS

The author's experience has been gained at the University of Khartoum, in the Sudan, formerly a University College enjoying a special relationship with London University. The last degrees awarded under this relationship were conferred in 1959. The London University syllabus has been applied rigorously until the recent separation. Since then some re-arrangement has taken place to include more lectures on the subjects of local importance, such as irrigation, refrigation and air-conditioning. At Khartoum students spend six years in the University. There is a preliminary year in general science, followed by an intermediate year in the mathematical or biological stream.

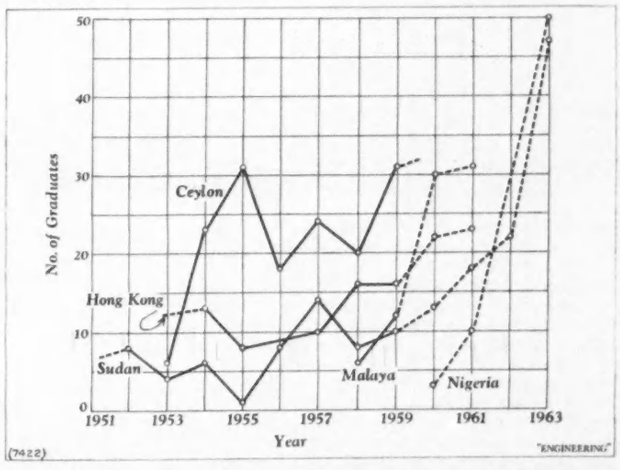
Admissions to the Faculty of Engineering are drawn from the mathematical stream. The student spends the first two terms in the Faculty reading three subjects only, engineering technology, mathematics and engineering drawing. This is followed by six months practical training in the well equipped Technical Institute and the State Railway Works. The first year is in effect an introductory engineering year. It should be realised that probably the first machine a prospective student sees, apart from the ubiquitous truck, is the locomotive drawing the train which carries him from a provincial town, some days trek from his home, to the capital. The second year in the Faculty of Engineering leads to the Part I examination. Up to the end of the second year the course is common to all the student intake. Division into the three main streams of civil, mechanical and electrical engineering takes place after successful completion of the Part I course. In a country where there is no family engineering tradition a student will tend to select the one stream of the three by which he will most quickly gain recognition for his professional capabilities. The majority, therefore, choose to become civil engineers, as on successful completion of the civil engineering course, a student can apply for exemption from Parts I and II of the professional examination of the Institution of Civil Engineers. The Institution of Mechanical Engineers affords no recognition of the mechanical engineering course.

Honours students are selected at the end of the second year in the Faculty and are given a project to carry out under the distant supervision of a member of the teaching staff, in addition to pursuing the ordinary course in the 3rd and 4th years. These projects have been found to be of immense value to the student as it is usually the first time the student has had the opportunity of working on his own initiative.

VACATION WORK

There has been little enthusiasm in the past on the part of employers to take students on vacation work. This is reciprocated by those students who have journeys of several weeks duration to and from their homes, and by the generality of students who find that the period of the long vacation coincides with that season of the year in which the climate is least conducive to physical and mental exertion.

It is well known that the reign of the expatriate engineer is drawing to a close. It is of the utmost importance that his place is taken by a national who has a thorough knowledge of the general engineering principles of theory and design. The new engineer must be aware of the engineering achievements of other countries so that he will be able to discover, plan and utilise the natural resources of his own country to the greatest advantages of his fellow countrymen.



Numbers of engineering students who have graduated at the Universities of Ceylon, Hong Kong, the Sudan and Malaya, and at University College, Ibadan, Nigeria, during recent years. The broken lines indicate the probable future trend.

The figure shows the number of engineering students who graduated from the Universities of Ceylon, Hong Kong, Malaya, the Sudan, and University College, Ibadan, Nigeria, in recent years. The Faculty of Engineering in Ceylon University was founded in 1953, that in the University of Malaya in 1958, and that in University College, Ibadan, in 1958. An impression of future numbers of graduates is shown by broken lines. These numbers are assessed from the numbers of undergraduates passing through the faculties at present, allowing an average percentage of withdrawals and failures. Half the undergraduates in the University of Hong Kong are drawn from Far Eastern countries outside Hong Kong. In Ibadan there will be an initial " bulge " reaching an output of at least 50 in 1963, but thereafter this output will settle down to about 30 graduates each year. There are, as yet, no Engineering Departments in the Universities of Ethiopia, Ghana, Rhodesia and Nyasaland, Uganda and the West Indies.

Versatile Light Utilities

A feature of current European production is the popularity of the light forward-control utility vehicle which can be adapted as van, station wagon, bus, motor caravan, ambulance or mobile shop.

By Gordon Wilkins

The use of mechanical assemblies derived from private cars is obviously an attractive way to reduce development and production costs and probably the greatest success is the Volkswagen Transporter. Here reduction gears in the rear hubs inherited from the war-time military vehicles were used to increase the ground clearance and provide the required gear reduction while retaining the standard passenger car elements. Corresponding increase in front ground clearance was obtained by using a special forked yoke piece carrying a stub axle in line with the end of the lower trailing arm in the Porsche front suspension.

However, production at the rate of about 500 a day has recently justified the design of a special engine and gearbox for the Transporter with more robust crankshaft and crank case, heavier gears and synchromesh on all four speeds. The difficulty with this model, as with most rear engined vehicles, is the inability to provide rear doors for loading. Instead, big side doors are provided on one or both sides on the van version. This problem led Fiat to produce the Multiple version of their 600 which has more of the passenger car than a van silhouette and sacrifices interior space in consequence. It is available as station wagon or taxi with seats for up to six people but is not as versatile as other vehicles in this category, and has not been such a commercial success. The chassis has been used by Italian coachbuilders for a variety of vehicles from open beach cars to vans but low volume of production has kept the prices high.

Thanks to the very low silhouette of their two cylinder two-stroke engine Goggomobil have been able to provide a rear door, with a shallow engine access hatch below it. However, Renault could not adopt such a solution with the Dauphine engine, so when designing the Estafette they put the engine at the front, driving the front wheels, and added a new heavier gearbox with synchromesh on all four speeds. Direct drive for the fourth speed is obtained by running a quill shaft through the length of the hollow main shaft. This configuration gives the benefits of a low flat floor with a full choice of side or rear entrances. Other successful applications of this layout are the DKW in Germany, Alfa Romeo in Italy and the Citreon in France which is a particularly good example, with corrugated panels and sufficient headroom to stand inside it without modification to the roof.

Structural limitations sometimes prevent adoption of the passenger car components. The Ford Thames vehicle uses the Consul engine but the structure did not readily accommodate the high pivot points necessary for the Macpherson front suspension, so they adopted a conventional coil spring and wishbone layout. With a front engine and forward control the radiator is usually mounted behind a grille in the front panel with the engine just behind it in a sound proofed box between two separate front seats but this prevents people moving across the front of the vehicle and necessitates opening a door on the traffic side. Commer, on their new vehicle using the Hillman Minx engine, house engine and radiator in a box under the centre seat in a row of three. The vehicle has a smooth front panel with no air intake; there is no obstruction to movement inside but considerable development was necessary to achieve satisfactory cooling with air intake and exhaust below the car.

Another problem for which different solutions have been adopted is the treatment of the front wheel openings. This affects appearance, handling and ease of entry. Volkswagen, Ford and others expose the front wheels and are thus able to use a full width front track, but a big step is necessary in the front door to clear the wheel arch and these vehicles cannot use sliding front doors.

The BMC J2 vehicle obtains sliding front doors at a cost of a 2½ in reduction in front track. On the Standard Atlas vehicle a similar solution has only been obtained at a cost of a 7¾ in difference between front and rear tracks, the front being only 3 ft 9 in. To increase front roll resistance the transverse front leaf spring has been clamped at two points. The BMC vehicles are unusual in having semi-elliptic front springs with a beam axle. Otherwise independent suspension is general and independent rear suspension is widely used on the Continent.

The two General Motors subsidiaries, Bedford and Opel, have adopted a slightly different formula, with semi forward control which keeps the engine mainly clear of the cab and locates the front entrance mainly aft of the wheel arches so that sliding front doors can be used.

This year is seeing a remarkable development in the conversion of these light utility vehicles into motor caravans for use as holiday homes or mobile offices. Their popularity is increased by the fact that they are the only type of private car which is exempt from purchase tax and yet not restricted to 30 m.p.h. outside built-up areas.

On a few conversions the height of the roof is increased to provide sufficient headroom for people standing inside but this makes an ugly vehicle and a more popular solution is an extending roof panel with flexible side enclosures. Martin Walter hinges the roof at one side and holds it open with struts at the other, the intervening space being sealed by a flexible fabric enclosure. Other manufacturers use collapsible struts to raise the roof, or a portion of it, straight upwards with fabric or transparent plastic to seal the space between it and the body of the vehicle. Accommodation is usually provided for four people by sleeping two on beds made by re-arranging the day-time seats, two more on stretcher beds slung below the extended roof. Equipment is completed by lockers for cutlery crockery and bedding and a wardrobe, a sink and cooker. Some two berth conversions also include a toilet.

As most of these vehicles are powered by small passenger car engines which are de-rated to permit the use of commercial grade fuel, the performance is not outstanding, and top gear ratios of the order of 5·6 : 1 have to be employed. In van form when laden to the manufacturers' recommended gross vehicle weight, power to weight ratios vary from 14·5 b.h.p. per ton for the Volkswagen to about 25 b.h.p. per ton for British vehicles like the Commer and Standard Atlas. In caravan form the performance is livelier but comfortable cruising speeds vary from 40 to 50 m.p.h.

With only the front seats occupied there is a heavy concentration of weight on the front wheels in front engined vehicles. This is obviously an advantage on front wheel drive types but those on which the drive is taken to the rear axle often suffer wheel spin on muddy surfaces. The alternative arrangement of rear engine rear drive-coupled with independent rear suspension has attractions in this respect.

(Above left) The Renault Estaffette can be produced as a high roof utility van or mobile shop or as the multi-seater shown here.

(Above right) The BMC Minibus is another multi-seater based on light van construction.

(Right) Headroom in the Dormobile caravan is obtained by hinging the roof.

MAGNETIC CHUCK

Rotary with Sine Angle Setting

A NEW Fimax magnetic chuck is a permanent magnet tool with a rotary table and sine angle setting in both planes.

The tool consists of a chuck measuring 14 in by 12 in mounted to rotate through a right angle about an upper horizontal axis and up to 47° about a lower horizontal axis at right angles to the first. The chuck and its lower support plate are made to form 10 in sine bars so that angles about both axes can be accurately set by means of suitable slips.

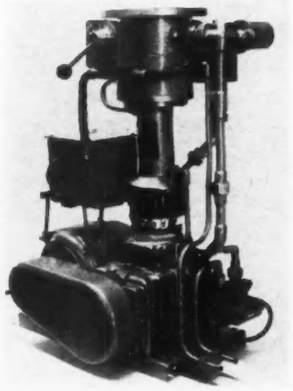
In use, the chuck is tilted more than the required angle using the screw mechanism and the slips are inserted. The chuck is then screwed down to nip them. Angles about the lower axis are set in the same way. The method is said to ensure extreme rigidity.

To set the unit about its vertical axis, degree divisions are engraved on the scale, but the arrangement of the sine bar support allows a 10 in sine bar to be used on its side. The removable operating lever may be used on either side of the chuck.

The unit is constructed from massive nickel iron castings accurately fitted, and with generous bearing areas. It is finished in green enamel with chromium fittings. The height of the FRCS1412 is 10½ in and the base area 23½ in by 23½ in. The working surface is 14 in by 12 in. The mounting is also available with a 14 in by 12 in T-slotted cast iron table in place of the magnetic chuck. A sine bar support bracket complete with 45° angle block and set of slip gauges can be supplied to fit either of the above. *Darwins Limited, Fitzwilliam Works, Sheffield 9.*

VACUUM PUMP

Single Lever Control



NOW available is a vacuum pump working down to 5×10^{-6} mm of mercury with all operations controlled by a single lever.

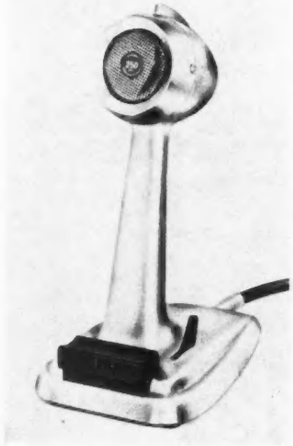
The operating handle has four positions: rough pump; fine pump; isolation; and air admittance. A quadrant movement separates the positions. Rough pump takes the pressure down to approximately 350 microns and then the diffusion pump takes over with the rotary pump acting as backing. The isolation position cuts off both pumps from the vessel.

In the event of accidental stoppage or power failure, the unit is automatically isolated; the backing line is closed by a magnetic valve and air is admitted to the admittance valve, there being a two second delay. This prevents oil being sucked back from the rotary pump. On re-connection the air admittance valve closes and there is a time lag to allow the backing line to be pumped down before the isolation valve again opens. If the cooling water supply fails the heater to the diffusion pump is cut off and a red light shows.

Two sizes are available, the first for vacuums to 5×10^{-6} mm of mercury with a rate of 23 litres per second, and the second to 1×10^{-4} mm of mercury at 100 litres per second. *N.G.N. Electrical Limited, Avenue Parade, Accrington.*

MICROPHONE

General Communication Work



THE 250 series of Turner microphones are designed for general communication work.

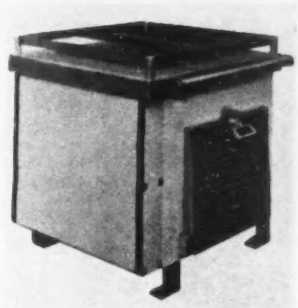
There are three models in the series numbered 250, 251 and 256. All three embody the firms "triple switching" action of push-to-talk, slide lock, and lift switch that is claimed to give greater speed and convenience in dispatching or public address work.

Model 250 is a high impedance dynamic instrument arranged to operate both microphone and relay circuits by one switch. It is stated to have a smooth response from 100 to 10,000 c/s and an output level of — 54 db. It is supplied with 20 ft of three-core (one shielded) cable. Model 251 is also a dynamic type but has a low impedance of 150 ohms and is supplied with four-core (two shielded) cable.

Model 256 is a crystal version of model 250 and has a response range from 60 to 8,000 c/s. The output level is — 51 db. It also is supplied with 20 ft of three-core (one shielded) cable. All three instruments are made of single unit die castings and are chromium plated. *Ad. Auriema Incorporated, 85 Broad Street, New York 4, NY, USA.*

ELECTRIC RANGE

For Ships' Galleys



ELECTRIC ranges for ships' galleys are now being made, based on a unit size.

Each unit has an oven measuring 21 in wide by 30 in deep by 17 in high and a total hot plate area of 24 in by 24 in. There are six solid anti-drip hot plates which can be switched on in two double and two single sections.

The units can be installed either singly or in groups of as many as the layout requires. Electrical loading for one unit is 15 kW, made up of 3 kW for the oven and 2 kW for each of the hotplate sections. The equipment is designed for use on 220V d.c. or 440V, 3 phase a.c. supplies.

All the electrical connections are taken by solid busbars across the top of the oven and down into a connecting chamber at the side which is accessible through a removable panel at the front. The oven is heated by sheathed wire elements and has a vitreous enamel finish. Three-position heat control is provided. The switches, together with pilot lights and fuses, are housed in a separate control panel.

Exterior finish of the unit is light grey vitreous enamel. Hob, fiddle bars and storm rails are of ground and polished mild steel and the oven door is stainless steel. Overall dimensions are 36½ in wide, 38½ in deep and 33½ in high to the hob. Deck clearance is 5 in and weight about 8 cwt. *General Electric Company Limited, Magnet House, Kingsway, London, WC2.*

MEASURING MICROSCOPE

For Small Holes

A ZEISS microscope is now being made for the particular purpose of measuring the size of holes down to 0·05 mm in diameter.

In operation a sphere of known diameter is made to touch diametrically opposite sides of the hole while under observation through the microscope. The amount of movement is then a measure of the diameter. Measurement is made at the intermediate image of the microscope by means of a screw micrometer eyepiece with a magnification of 15. A distortion-free telecentric objective with a magnification of 5 is used.

Since both the microscope and the workpiece are fixed while the measurement is being made, there are no errors due to tilting.

The measuring depth can be read from an adjustable drum. The eyepiece has internal reading to facilitate operation. The measuring spheres are mounted on glass threads so that they are unlikely to be damaged in use; a red warning light shows when they begin to function. Spare spheres are available in sets of ten. The full range of measurement is from 0·05 mm to 2 mm, with an accuracy of $\pm 0{\cdot}5 + \left(\frac{0{\cdot}8}{n}\right)$ microns where n is the number of measurements. *C.Z. Scientific Instruments Limited, 12a Golden Square, London, W1.*

POWDER LANCE

Cuts Any Thickness

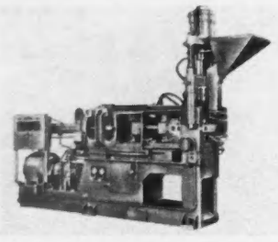
CHIEF claim for the new Oxweld ACL4 powder lance is that it will cut through any thickness of concrete, steel or hard material.

The cutting is simplified by the accurate control of heat release possible with this lance. Lengths of standard black iron pipe are fitted into the front end of the ACL4, which is connected to an oxygen supply and a source of the Oxweld metallic powder mixture. The oxygen and the powder are mixed in the pipe and carried to the material being pierced or cut. The mixture is ignited at the pipe mouth, burning at a temperature of approximately 8,000° F. For concrete, a mixture of iron and aluminium powder is used known as Oxweld 201. Aluminium powder added to the metallic powder makes it possible to cut really thick concrete.

In a recent test, 18 in thick slabs of concrete were cut at the rate of 2 to 3 linear ft per hour and pierced in 2½ minutes. About 1,000 cu. ft of oxygen, 40 lb of powder and 10 ft of iron pipe are consumed per sq. ft of concrete cut. *Union Carbide International Company, 30 East 42nd Street, New York 17, NY, USA.*

INJECTION MOULDER

High Speed Automatic



THE new Lester L150, 4 to 6 oz injection moulding machine has a short cycle time and high injection speeds to make use of the newer moulding materials.

An extra large pump driven by a 25 h.p. motor gives a dry cycle time on average of 4·7 sec, but with thin wall disposable packaging work an auxiliary pump can be fitted to give a dry cycle time of 3·5 sec. It is this high pumping capacity that ensures the rapid injection speeds needed for mouldings of high physical properties.

The vertical injection assembly can be retracted to give immediate access to the heating cylinder nozzle. The full injection load is taken to a thrust block on the machine base, so relieving loading on the nozzle and sprue bush. The injection unit incorporates as a standard item a cut off attachment for use with low viscosity materials such as nylon.

The injection cylinder utilises a one piece spreader unit which is internally heated and has accurate temperature control. This one piece construction is claimed to eliminate such faults as leakage, breakage, inaccessibility, and decomposition of materials.

On fully automatic cycling, protection is provided for the mould faces to guard against an obstruction between them. An obstruction of 0·01 in is sufficient to operate the device and a red light shows that the machine has stopped. Standard features include mould speed adjustment, stroke adjustment, plunger speed adjustment and a hydraulic ejector cushion for the easy removal of intricate parts. *J. Brockhouse and Company Limited, Elms Works, Wolverhampton.*

PROTECTIVE HELMET

Quick Change Window

A NEW model of the Saferhelm protective helmet has recently been introduced—the Mark 11.

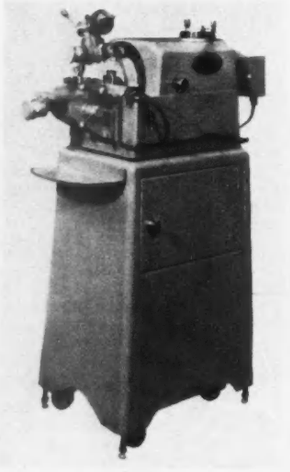
This helmet is designed for the protection of operators during shotblasting and similar processes and in the new design of shell the air opening is at the rear. The window aperture has been enlarged and has an inner window which does not normally need replacing except when broken or otherwise accidentally damaged.

A feature of this helmet is the outer window which is made of tough clear pvc. As this is liable to become marked and obscured during use, it has been made replaceable by the simple process of using a continuous sheet that is pulled from a reel as required. A cassette fitted into the front of the helmet is used to store the pvc, and changing of the cassette itself takes only a matter of seconds. Each one holds enough material to replace the window completely eight times.

Working trials have proved the helmet to be very efficient and considerable time saving has been achieved by the method of window changing as compared to other types when the outer window has to be removed from its frame and a new section of pvc fitted before returning the window to the helmet. *Heafield Industries Limited, Spa Lane, Derby.*

GRINDER

For Spiral Point Drills



SPIROPOINT is a machine that has been developed specifically for sharpening spiral point drills.

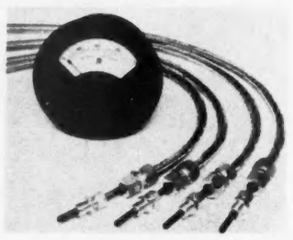
The advantage of a spiral pointed drill is that the tendency to wander at the start of a hole is eliminated, and the drill is said to need less thrust.

There are two controls on the machine. The first is set to the diameter of the drill to be sharpened and the second to the clearance angle. The drill is held in a positioner that swivels clear for loading, and then is advanced to bring the point up to the setting stops. The work slide is then retracted and the drill fed to the wheel. Stock removal is controlled by a micrometer knob set for 0·001 in increments. For faster removal a mist coolant system is included.

During grinding, the drill remains still and the wheel swings around it to give the correct shape. The wheel can be dressed with a trueing unit that is swivelled into position. The trueing device is adjustable so that drill points rom 90° to 180° can be ground. The machine is mounted on castors and fitted with screw jacks for levelling. *Charles Churchill and Company Limited, Coventry Road, South Yardley, Birmingham*

PYROMETER

For Diesel Engine Exhausts



NOW available is a pyrometer for measuring the temperatures of the exhausts of diesel engines.

The instrument comprises up to eight iron/constantan thermocouples in stainless steel sleeves, and a meter of the moving coil type. Being made to withstand vibration the meter can be mounted on the instrument panel of the engine.

The thermocouples are mounted through an entry port in the exhaust manifold and connected to the meter which has eight pairs of terminals moulded into the back. A nine-position switch on the front of the meter allows the operator to select any particular thermocouple and the temperature can be read directly from the dial. The ninth position is "off" and puts a short circuit across the meter. The switch plate is engraved with channel numbers according to the number of thermocouples employed.

The zero adjust button is covered by the selector switch so that it cannot be altered without removal of the latter. A bi-metal strip compensates for ambient temperature changes after setting. The dial is scaled to read up to 1,600° F with the maximum accuracy at 1,200° F.

The meter can be calibrated for any length of 22 s.w.g. lead from the thermocouples, up to 50 yards. In cases where the instrument is remote from the engine, longer distances can be covered by using heavy gauge compensating leads. The instrument is suitable for any type of diesel engine, whether mobile or stationary, and has been fitted to check the exhaust temperature prior to using the gas for turbo-charging. *Savage and Parsons Limited, Watford By-Pass, Watford, Hertfordshire.*

POWER METER

For Audio Frequencies

TYPE TF 1347 power meter is an instrument for audio measurements over a wide range of impedance.

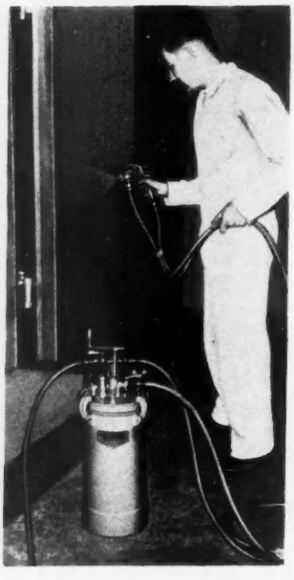
The permissable range is from 2·5 ohms to 20 kilohms in eleven steps. The frequency characteristic is substantially flat from 50 c/s to 20 kc/s and its ten power ranges, covering 10 μW to 6 W, and the 5½ in meter provide excellent discrimination.

Functionally the instrument may be considered as a variable attenuator whose input is adjustable in steps and whose output is applied to a voltmeter calibrated in terms of power input to the attenuator.

The circuit consists of three parts providing impedance selection, attenuation and indication. Impedance is selected by a tapped matched transformer connected to the input terminals of the instrument by an eleven-position switch. A ten-step resistive attenuator forms the power range multiplier and presents a constant impedance to the secondary winding of the matching transformer. The attenuator is terminated by the indicator circuit which consists of a moving coil meter and bridge-connected rectifier. The accuracy for powers greater than 200 μW is $\pm$ 5 per cent of the reading. For lower powers the accuracy is $\pm$ 10 μW. *Marconi Instruments Limited, St. Albans, Hertfordshire.*

SPRAY GUN

Low Mist-Producing Nozzle



TO solve the problem of spray painting in open shops, a special low mist nozzle has been developed.

The nozzle is made up of a low mist air cap and a fluid tip combination and fits the JGA type gun. The makers state that it will allow high class painting to be done with almost complete absence of overspray. A low velocity of air flow is achieved with normal air pressures of 30 lb per sq. in, and good atomisation is obtained with freedom from paint rebound.

Tests on the nozzle set, which is available in three sizes, show that the reduction in mist depends to some extent on the type of paint used. Mist is lowest with wagon paint, red oxide primer, synthetic primer, filler, oil bound distemper, and emulsion paint. Slight mist is produced with high class synthetic finishes, household type undercoat and hard gloss finish. Coverage is excellent. *Aerograph DeVilbiss Company Limited, 47 Holborn Viaduct, London, EC1.*

Turning Points

With the accumulation of specialised knowledge, the nuclear industry is now in a position to repay the borrowed capital of engineering know how with which it took the first uncertain steps of its career. Pressure-vessel construction, the handling of toxic materials, temperature-resistant structural components, welding or exotic materials, large-diameter expansion joints, and solvent extraction are some of the instances where the nuclear engineer's expertise has found application in other industries. High-speed rotors are another field where reactor construction and nuclear research have given a sudden impetus to development. Recent advances in gas bearings and ultra-centrifuges for isotope separation are reviewed below.

Gas Bearings

Static or Dynamic

Of the two gas bearing types—hydrostatic and hydrodynamic—the former finds application chiefly under conditions of high static loading. Hydrostatic gas bearings use an external source of compressed gas to provide a film separating the bearing surfaces. The Hovercraft and other ground-effect vehicles are an unusual application of the principle, although it can be applied to rotating shafts as well. At the CERN high-energy physics laboratory near Geneva a hydrostatic gas bearing was developed to facilitate moving large bubble chambers weighing 300 tons over the experimental floor of the recently inaugurated 25 GeV proton synchrotron. For applications requiring a very high degree of reliability, the external compressed gas required by hydrostatic gas bearings introduces a potential trouble source. The hydrodynamic principle, in which the differential gas pressure is generated within the bearing, results in a self contained bearing without external connections—at the expense of introducing other limitations. (ENGNG., vol. 182, 1956, pp. 559-562.)

For Small Shafts and High Temperatures

The viscosity of liquid lubricants may be a thousand times greater than that of gases. As a consequence, the load-carrying capacity of gas bearings is severely limited, and the bearing area for a similar load would be some thousand times bigger for a gas bearing than a liquid lubricated bearing. The ratio of the linear bearing dimensions would then have to be of the order of $10^{9/2}$, or around 30, for a comparable design of liquid and gas bearings. Fortunately, liquid bearings have to be considerably overdesigned for small shafts because of the requirements of shaft rigidity and heat transfer, while gas bearings can be designed for the bare necessities. Even so, gas bearings are somewhat larger than liquid bearings, but the difference is not objectionable. Gas as a lubricant really comes into its own as the operating temperature is increased. Unlike hydrocarbon lubricants, the viscosity of gases, and hence the load carrying capacity of gas bearings, increases with temperature. At 150° F the viscosity of a machine oil drops to about one quarter of the value at 60° F; but the viscosity of air increases by about 15 per cent over a corresponding temperature change.

Advantages in Nuclear Applications

Gas bearings became associated with the nuclear industry as a result of some very special requirements imposed by reactor applications. Maintaining extreme purity in the coolant circuit of gas-cooled reactors poses some problems of shaft sealing. Maintenance is usually difficult owing to induced radiation in the coolant, and the stability of liquid lubricants under prolonged irradiation may not be entirely satisfactory. In addition, the temperature of reactors has been going up steadily, and the advantageous viscous properties of gases become more and more important. When using the hydrodynamic bearing principle, external connections can be eliminated and it is possible to "can" the circulators completely in order to eliminate the leakage of contaminated coolant to the atmosphere.

The Trick is in the Making

The film thickness in a gas bearing is in the order of 0·0001 in, permitting a bearing clearance of about 0·0005 in per inch of diameter. As a suitable clearance must be maintained through a wide range of operating conditions, the key to the successful application of gas bearings is in the design and machining. Bristol Siddeley have developed a line of gas bearing pumps and circulators for use with all usual reactor coolants from helium to mercury, with power ratings from 0·7 to 1,740 h.p. Fig. 1 shows a schematic cross-section of the motor unit adapted to liquid and gas duty. The pumps are designed for installation in any position with a gimbal-mounted thrust bearing and two journal bearings for support. The lubricant may be the gas being circulated, or a special inert filling as in the liquid-pump application. The maximum operating temperature and pressure are 1,300° F (700° C) and 1,800 lb per sq. in respectively. Some sliding of bearing surfaces occurs at start up, particularly in the thrust bearing, before the dynamic gas film is established. Although rubbing could be completely eliminated by using external compressed gas during the starting period—in fact, temporarily converting the bearing to the hydrostatic principle—but by carefully selecting the materials for their anti-galling properties, wear can be kept to a minimum. Some bearings have been in operation for a number of years without showing signs of wear.

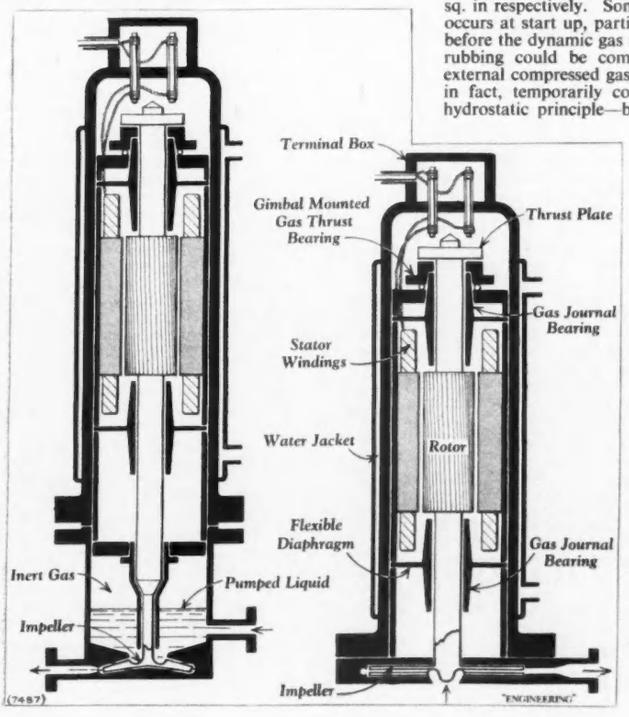


Fig. 1 (left) By fitting a different impeller, the Bristol Siddeley gas bearing motors may be used with liquid or gaseous reactor coolants.

Ultra-centrifuge

Uranium Enrichment

A pilot-scale uranium enrichment plant using seven gas centrifuges will be started by Thor-Westcliffe Development of Santa Fe, New Mexico, near Pittsburgh, Kansas. Centrifuge enrichment was one of the separation processes studied during the war under the Manhattan project, but success with mass spectroscopy and the solution of the problems of quantity production by gaseous diffusion later pushed the centrifuge into the background. Development lagged until the Institut für Wissenschaftliche Apparate in Aachen, Germany, became interested, and the gas centrifuge was brought to a high degree of refinement under the direction of Dr. Konrad Beyerle. Thor-Westcliffe plans to buy the centrifuges from Aachen, and a USEAC press release points out that if approved the transaction will be the first licensed purchase of foreign-made nuclear equipment in the Commission's history. Results of the enrichment study will no doubt be watched with interest by the UKAEA in view of the increasing demand for enriched fuel in the advanced power and small propulsion reactors planned. It is believed that centrifuge enrichment, not gaseous diffusion, is the most suitable for West European conditions of power cost and supply.

Multiple Effect from Single Centrifuge

The separation factor α for a gas centrifuge is a function of the absolute isotropic mass difference $m_1 - m_2$. In all other separation processes the governing quantity is the ratio of mass difference to average mass, indicating that the process becomes less effective at the heavy end of the periodic table. As a result, the gas centrifuge has the best chance of competing with other processes where it counts most: the enrichment of uranium. Simple centrifuges may be built into cascades similar to a gaseous diffusion plant, but the separation effect per centrifuge can be greatly increased in a refinement known as the convection centrifuge. A schematic arrangement of the Beyerle design is shown in Fig. 2. The rotor is a slender vertical cylinder suspended in a vacuum chamber or in low-pressure hydrogen. Speed of rotation is about 30,000 r.p.m. with a peripheral

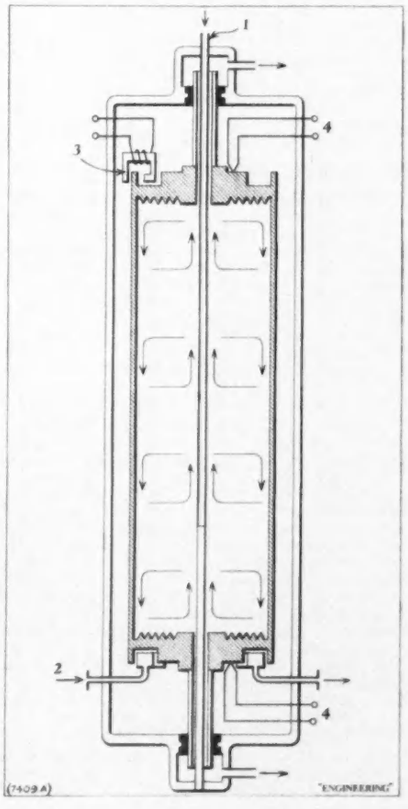


Fig. 2 (right) A promising uranium enrichment method is the convection centrifuge, which will be used in a pilot scale enrichment plant in the United States.

1 Inlet
2 Cooling coil
3 Heater
4 Thermocouple

velocity of 1,000 ft per sec. Gaseous uranium hexafluoride feed enters the rotor through the stationary tube (1) concentric with the rotor shaft. Convection currents are set up in the rotor as a result of compression of the gas near the rotor periphery. To maintain the convection currents, a small temperature difference between the upper and lower rotor ends is maintained by means of a cooling coil (2) and an eddy-current heater (3), converting the centrifuge into a rotating thermal diffusion column. Satisfactory operation of the convection centrifuge depends on the maintenance of the optimum temperature difference, and two thermocouples (4) are provided for the purpose. The light and heavy fractions are drawn off at the top and bottom of the rotor casing.

Centrifuge Performance

The separation potential of the gas centrifuge is proportional to the fourth power of peripheral velocity and to the length of the rotor. To reduce hold-up of gas in the plant, it is desirable to achieve very high peripheral velocities by high-speed rotation of a small diameter rotor. The length of the rotor is limited by vibration problems. In the Beyerle design the shaft is supported in damped flexible bearings and the rotor is carefully balanced in three or five planes. Enrichment also depends on the throughput per rotor. Fig. 3 shows the variation for a 13·4 cm diameter and 63·5 cm long rotor operating at a peripheral speed of 280 meters per second. In practice, the optimum performance with this particular rotor is realised at a throughput between 0·5 and 1·0 grammes of uranium hexafluoride per minute, where the enrichment potential δ U is above 2×10^{-3} grammes per minute.

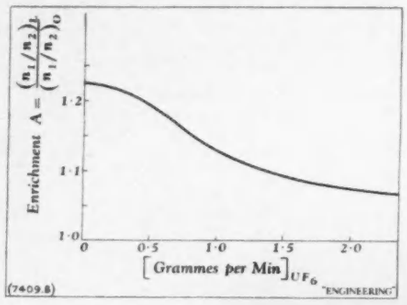


Fig. 3 (above) Enrichment in a single rotor is a function of throughput rate, here shown for the centrifuge Mark IIIB.

Notes and News

South African Reactor Order Imminent

An order will be placed for a 5 MW research reactor by the South African Atomic Energy Board within the next four months, it was announced by Dr. A. J. A. Roux, the Board's research director. Reviewing the position of the Union in the field of atomic energy at a meeting of the South African Institution of Mechanical Engineers, Dr. Roux emphasised the desirability of catching up with other nations in nuclear research in view of the Union's leading position as a supplier of raw materials; and that the Union's manufacturing industries have reached the required maturity to establish a nuclear branch with success. The prerequisite for research or industrial development was a suitable reactor for training, material and component testing, and isotope production. A reactor suited both to the country's requirments and pocket book would have a flux of 10^{13}, with a heat output of about 5 MW. The specification appears to fit several reactors, including AEI's MERLIN and the products of the American companies ACF—Allis Chalmers, Babcock and Wilcox, Combustion Engineering, and AMF Atomics.

International Consortium for Fuel Fabrication

An international consortium has been formed under the name Austro-Chematom to manufacture reactor fuel from Canadian ore concentrates in Europe. The participating firms are Oesterreichische Stickstoffwerke AG of Linz, with a 60 per cent interest, the German chemical and noble metal manufacturers Degussa of Frankfurt am Main, and Rio Tinto Mines, both with a 20 per cent interest. Uranium concentrates will be supplied from Rio Tinto's Canadian mines which as a group are the largest uranium producers in the Commonwealth.

Burst Slug Detection Using Radioisotopes

A faulty fuel element may be located by analysing the coolant stream contamination if small amounts of tracer elements have been added to the fuel during fabrication. Suitable tracers are erbium, gallium, holmium, iridium, osmium, platinum, radium, scandium, terbium, thulium and ytterbium. The tracers are used in pairs for each fuel element in concentrations below 0·1 per cent by weight. Following a fuel element failure, the coolant is analysed for the radioactive products of irradiated tracer elements and the damaged subassembly located. Research at the Battelle Memorial Institute has verified that the selected elements were suitable for alloying with nuclear fuels. (M. Poberskin *et al.*: "A Study of the Feasibility of a Tracer System for Locating a Fuel Element Failure in Reactors," *Nuclear Science Abstracts*, No. 1095, vol. 14, No. 1.)

Semi-Homogeneous HTGCR from Japan

If the fuel of a high-temperature reactor is dispersed in graphite in such a way that the diameter of the fuel granules does not exceed a few microns, the fission products recoiling from a fission event have sufficient energy to escape from the fuel granules. As uranium oxide and graphite can be separated by simple means, the reprocessing costs would be low compared to methods involving chemical treatment. The Japanese Atomic Energy Research Institute is studying the possibilities of a high-temperature reactor using semi-homogeneous fuel elements for operation around 1,800° F (1,000° C) and the granular fuel dispersion in graphite is one of the possibilities investigated.

Winnett Boyd Receives American Backing

An interesting side issue of the Canadian controversy over the country's power-reactor programme emerged during the Gas-Cooled Reactor Symposium of the Franklin Institution in Philadelphia. Mr. Boyd announced completion of an agreement with the American industrial research consultants Arthur D. Little Inc. of Cambridge, Mass., for further development of the Daniels-Boyd high-temperature reactor concept. Mr. Boyd has so far not succeeded in obtaining Canadian governmental backing for his ideas in spite of an extensive publicity campaign in which the relative merits of heavy-water and high-temperature reactors were subjected to spirited public discussion. (Atomic Review, 23 Oct. and 13 Nov., 59). In the United States on the other hand there is considerable interest in high-temperature reactors and Sanderson and Porter, General Atomics, and the Oak Ridge National Laboratory all have high-temperature projects in hand. The association of Winnett Boyd and Arthur D. Little will enable the latter to enter the high-temperature field with a ready design—and Mr. Boyd to give the Canadian government a well timed jolt. Arthur D. Little is an independent industrial research organisation employing over 560 scientists and engineers at seven branches in America and Europe. Opening of a Canadian branch in Toronto is under discussion.

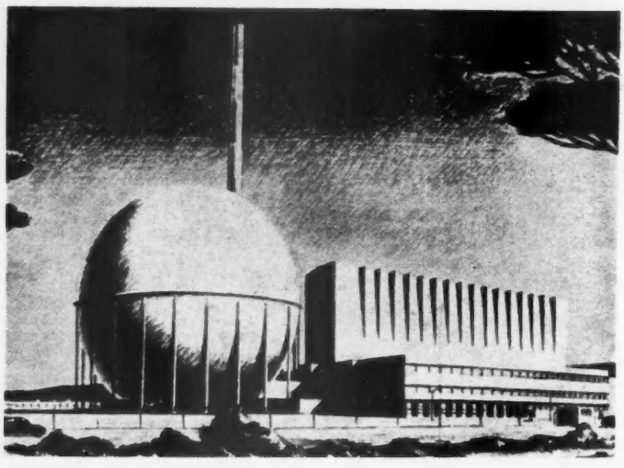


Fig. 4 (right) Artist's impression of the Punta Fiume 150 MW boiling-water reactor being built for SENN.

Fast Neutron Shielding at Dounreay

Neutron shields for fast reactors must first moderate the escaping neutrons, and then provide a suitable absorber for mopping up. At Dounreay, the shield is built of borated graphite blocks. Both boron and graphite are good moderators, and boron has in addition a thermal capture cross-section of 715 barns (2×10^6 times that of carbon). Although falling short of the capture properties of cadmium (2,500 barns), boron has the advantage that only soft gamma radiation of about 0·5 MeV is emitted following absorption of a neutron. In contrast cadmium emits several hard gammas, necessitating a secondary gamma shield in addition to the neutron absorber. The Dounreay shield was built of graphite containing 0·3 per cent boron, with a few blocks enriched to 5 per cent. Borated graphite is produced by the Morgan Crucible company in a patented impregnation process. Anhydrous borax is the preferred carrier: it melts at 700° C and readily wets the graphite, but owing to high surface tension will not escape. As the graphite pores are usually interconnected in commercial grades of material, the anhydrous borax will form a continuous web-like structure within the graphite. The resulting mechanical bond obviates the need for additional cementing material such as tar or pitch. The Dounreay shield is roughly cylindrical and is pierced by a number of holes in irregular directions. As a result, 500 different patterns had to be machined, some of them apparently so complex that wooden test pieces were used to check the sequence of operations. Before shipment, the layers of shielding were assembled at Morgan's shops as a final check. Complexity of the shielding geometry may go a long way to explain the fast reactor's high cost.

Aluminium Alloys in Water Reactors

Corrosion resistance of commercial grade iron-nickel-aluminium alloys is eight times less in high-temperature water flowing at 20 ft per sec than under static conditions. Little improvement can be expected from varying the alloy composition and it is probable that some form of inhibitor must be found before aluminium can be substituted for stainless steel in a water reactor. A suitable inhibitor might be phosphoric acid or silica at a low pH value, but the treatment would render the liquid incompatible with mild steel components of the external coolant circuit. Formation of corrosion resistant films may offer a possible solution, but material testing under conditions of heat transfer is required. As an aluminium based fuel element can would be thicker than a similar can of Zircaloy, there is little chance that the latter will be replaced as canning material for oxide fuel, particularly in view of the reduced price of Zircaloy tubing. (Aluminium Alloys for Water Cooled Reactors by E. C. W. Perryman, *Journal of the Institute of Metals*, vol. 88, page 62).

Reactor Notes

Turbines for Candu: AEI will supply a 220 MW turbo-generator set for the Canadian nuclear plant CANDU. AEI have also supplied generating equipment for the power demonstration project NPD-2.

Architecture from Italy: Details of the architectural treatment of Italy's 150 MW boiling water reactor built for SENN are shown in Fig. 4.

Delay at Dounreay: The Select Committee on Estimates reported that delays at Dounreay were caused by repercussions from the Windscale incident and the Fleck reports, manpower shortages, and a certain loss of faith in the practicability of the system at a crucial stage of the design.

Resumption of Hunterston: The Hunterston project is again in full swing and the bottom head and support course of the pressure vessel has been lifted into the biological shield by the goliath crane.

Symposium on Containment: The Glasgow Royal College of Science is holding a symposium on nuclear reactor containment buildings and pressure vessels from 17 to 20 May. Numerous American and British papers will be presented.

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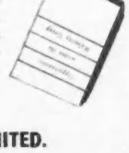

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UNIVERSITY OF NOTTINGHAM

RESEARCH FELLOWSHIP IN PRODUCTION ENGINEERING

ENGINEERS, PHYSICISTS or MATHEMATICIANS, with research or industrial experience, are invited to apply for the above Fellowship, value £750 per annum, plus membership of the Universities' Superannuation Scheme. Conditions of appointment and application form to be returned by 19th March from the REGISTRAR. B 428

AIR MINISTRY

AIR MINISTRY Works Designs Branch requires in LONDON and PROVINCES ENGINEERING DESIGNER DRAUGHTSMEN experienced in preparation of pipework and mechanical and electrical plant layouts. Candidates should have served recognised apprenticeship or had equivalent training and also have had practical experience. O.N.C. an advantage. Financial assistance and time off given for recognised courses of study. Promotion and pension prospects. Five-day week with 18 working days leave per year initially. Overseas tours for which special allowances granted.

Salary in LONDON ranges from £680 (at age 25) to £900 p.a. for men; from £673 to £868 p.a. for women. Somewhat lower in PROVINCES. Commencing salary dependent on age, qualifications and experience. Applicants, who must be natural born British subjects, should write to AIR MINISTRY, W.G.c., LACON HOUSE, THEOBALDS ROAD, LONDON, W.C.1, or to any Employment Exchange (quoting Order No. Kings Cross 3743), giving age, details of training, qualifications, full particulars of former posts held and copies of any testimonials. Candidates selected will normally be interviewed in London and certain expenses reimbursed. G 846

AIR MINISTRY

AIR MINISTRY require STATION ENGINEERS (G.D.) and STATION ENGINEERS (MECH.) at R.A.F. and M.T.C.A. Stations. The work of Station Engineer (G.D.) consists of installation, operation and maintenance of high and medium voltage electrical distribution systems, electrical power and lighting installations, control systems and generating plant: knowledge of heating and ventilating plant and diesel engines an advantage. Station Engineer (Mech.) are concerned with diesel power plant, steam and hot water heating systems, refrigeration and air conditioning and miscellaneous workshop plant, tools and equipment. Commencing salary according to age, qualifications and experience. Salary ranges £680 to £850. Candidates must hold O.N.C. Electrical or Mechanical/City and Guilds Electrical Technicians Certificate/2nd Class M.O.T. Certificate, or equivalent, and must also have had recognised apprenticeship with firm of good repute plus 3 years' employment in electrical or mechanical and engineering, preferably on operation and maintenance of mine, factory or workshops plant and services. Preference to candidates with supervisory experience. Opportunities for promotion up to Technical Grade A, maximum salary £1565 (National Rate) and pension prospects. Five-day week, three weeks three days leave a year initially. Internal training courses are provided and attendance at technical colleges by suitable candidates is sponsored. Overseas tours for which special allowances are payable in addition to higher salary. Applications normally from natural born British subjects only, up to age 55 years. —Write, stating age, qualifications and experience, to MANAGER (P.E.1), PROFESSIONAL AND EXECUTIVE REGISTER, MINISTRY OF LABOUR, ATLANTIC HOUSE, FARRINGDON STREET, LONDON, E.C.4. No original testimonials should be sent. Only applicants selected for interview will be advised. G 845

AIR MINISTRY

AIR MINISTRY Works Designs Branch requires in LONDON CIVIL ENGINEERING DESIGNER DRAUGHTSMEN with adequate training and drawing office experience in one or more of the following:—(*a*) Roads, pavements, earthworks and stormwater drainage; (*b*) Foul drainage and sewage disposal; (*c*) Water supply and distribution. Some site experience and possession of recognised technical qualification an advantage. Financial assistance and time off may be allowed for recognised courses of study. Promotion and pension prospects. Five-day week with 18 working days leave per year initially.

Salary ranges from £680 (at age 25) to £900 p.a. Commencing salary dependent on age, qualifications and experience. Applicants, who must be natural born British subjects, should write to AIR MINISTRY, W.G.c, LACON HOUSE, THEOBALDS ROAD, LONDON, W.C.1, or to any Employment Exchange (quoting Order No. Kings Cross 3746) giving age, details of training, qualifications, full particulars of former posts held and copies of any testimonials. Candidates selected will normally be interviewed in London and certain expenses reimbursed. G 840

DRAUGHTSMAN

Applications are invited for the above post, which is located in Birmingham.

The work is interesting and varied and is mainly in connection with the design of industrial heating equipment. A knowledge of combustion technique and the use of refractories would, therefore, be an advantage.

Candidates should possess the Ordinary National Certificate in Mechanical Engineering as a minimum qualification.

The salary for the appointment, which is pensionable and subject to medical examination, will be within the range of £733-£853 per annum.

Applications, stating age, qualifications and experience, together with the names of two referees, should be addressed to the INDUSTRIAL RELATIONS OFFICER, WEST MIDLANDS GAS BOARD, 6, AUGUSTUS ROAD, EDGBASTON, BIRMINGHAM, 15. G 848

TROPICAL PRODUCTS INSTITUTE

(D.S.I.R.) London, requires Experimental Officer/Asst. E.O. in section working on development of new products and processes for utilisation of tropical plant and animal materials, and investigations into uses of solar energy. Minimum qualifications:—G.C.E. "A" level in physics and another science or mathematics subject or equivalent. Over 22, Pass degree in Physics, or equivalent generally expected. Knowledge of, and experience with, general laboratory and plant instrumentation and electronics an advantage. Age at least 26 for E.O. Salary ranges:—(Men) E.O. £1005-£1233. A.E.O. £397 10s. (age 18)-£880. Forms from MINISTRY OF LABOUR, TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1. Ref. 88/OA. Closing date, 28 March, 1960. B 431

SHEFFIELD CORPORATION WATERWORKS

YORKSHIRE DERWENT SCHEME

Applications are invited for the following appointments on the staff of the Waterworks General Manager and Engineer (A. B. Baldwin, M.Eng.):—

TWO CHIEF ASSISTANT ENGINEERS (c/e Sub-sections, J.N.C. Scale "A" salary £1215 to £1445.

Successful applicants will be engaged upon the design and construction of the works of the Yorkshire Derwent Scheme, comprising a river intake and treatment plant, a 40 mile aqueduct, service reservoirs, pumping stations and plant.

Applicants must be Chartered Engineers experienced in the design and construction of major works and previous employment on similar water supply schemes would be an advantage.

Appointments are superannuable[1/2] and subject to medical examination and to the national conditions of service as applied by the City Council.

Applications, stating age, qualifications, present and past appointments (with dates and salaries), details of relevant experience and schemes engaged upon and quoting the names and addresses of two referees should reach the undersigned not later than the 12th March, 1960.

JOHN HEYS,
TOWN CLERK.

TOWN HALL,
SHEFFIELD, 1. B 430

FRANCIS SHAW & CO. LTD.,

Rubber, Plastic & Hydraulic Machinery Engineers,

MANCHESTER

The Company invites applications for the following appointments:—

PROJECT ENGINEER to carry out original design work and the preparation of necessary specifications and be capable of dealing with customers' technical problems on specialised designs.

This is a senior post requiring an enterprising man with graduate or equivalent qualification who will be prepared to travel extensively abroad.

SALES ENGINEER with sound engineering ability, preferably in the rubber and/or plastics industries, aged 28 to 35 years.

The possession of H.N.C. engineering will be an added advantage. The successful applicant will get a thorough training in all aspects of this work.

ESTIMATOR with Drawing Office experience in medium/heavy engineering, preferably trained in Commercial estimating where a high standard of technical correspondence was required.

The possession of H.N.C. in Mechanical Engineering would be an advantage.

HYDRAULIC DRAUGHTSMAN for the design and detailing of hydraulic presses and ancillary equipment. Applicants should have experience in press and press circuitry design and have the minimum qualification in Mechanical Engineering of an Ordinary National Certificate.

MECHANICAL DRAUGHTSMEN for the design and detailing of a wide variety of medium/heavy products for the rubber and plastics industries.

Applicants must have the minimum qualification in Mechanical Engineering of an Ordinary National Certificate.

JIG AND TOOL DRAUGHTSMAN for the design and detailing of Laboratory equipment and special purpose machinery.

Applicants should have had experience in this type of work including the design of Die-heads and Moulds, preferably as applied to the rubber and plastics industries. Applicants must have the minimum qualification in Mechanical Engineering of an Ordinary National Certificate.

ELECTRICAL DRAUGHTSMAN for the design and detailing of circuit diagrams and conduit layouts.

Applicants should have had experience in motor control gear and diagram work and should be in possession of the minimum qualification in Electrical Engineering of an Ordinary National Certificate.

The Company operates a non-contributory Pension Fund and Life Insurance Scheme.

Applications, which will be treated in confidence, should give fullest information and salary required and be addressed in writing to The Personnel Manager, Corbett Street, Manchester, 11.

B 429

DESIGN EDITOR

ON THE STAFF OF

"ENGINEERING"

Engineers with design experience are invited to apply for the post of Design Editor.

The successful applicant will be responsible, after initial training, for the Design section of the journal. He will be required to prepare articles himself and to edit articles written by outside authorities. He will be expected to keep himself well informed on engineering design trends.

One-day and two-day visits to works and laboratories in the U.K. are fairly frequent, and there are occasional visits abroad. Editorial colleagues are mostly university graduates or members of professional institutions but such qualifications are not essential; nor is previous journalistic experience.

An imaginative interest in writing and in engineering design is absolutely necessary.

Age not more than 35. Good salary and other benefits.

Please send details in envelope marked "Confidential," to:—

THE EDITOR,
"ENGINEERING,"
36 BEDFORD STREET,
LONDON, W.C.2.

B 441a

THE CALTEX ORGANISATION

require

DESIGN ENGINEERS

for service both in London and overseas to perform design work for oil refineries and associated facilities.

General requirements are:—

(*a*) Degree in Mechanical or Chemical Engineering.

(*b*) 2 to 4 years' experience in oil or chemical industry.

Preferred age group 28-32 years. Commencing salary would be dependent upon qualification and experience. For Foreign Service, additional living allowances are paid and free medical attention, air-conditioned accommodation provided plus an initial kit allowance and attractive vacation and Benefit Plans.

Apply in writing quoting "ETS," with full particulars of qualifications and experience to:

CALTEX SERVICES LIMITED,
CALTEX HOUSE,
KNIGHTSBRIDGE GREEN,
LONDON, S.W.1.

B 406

NORTHAMPTON COLLEGE OF ADVANCED TECHNOLOGY

ST. JOHN STREET, LONDON, E.C.1.

Applications are invited for appointments as

LECTURER and SENIOR LECTURER

in the Department of CIVIL and MECHANICAL ENGINEERING, dating from September, 1960, or earlier, in regard to the following subjects:—**MECHANICS OF MACHINES, APPLIED THERMODYNAMICS, STRENGTH** and **PROPERTIES OF MATERIALS, MECHANICS OF FLUIDS.**

Applicants should be qualified to teach in courses for the Engineering Degree and Diploma in Technology and for Senior Lectureships should be able to make some contribution at post-graduate level in teaching or taking charge of research projects. Facilities are available for research by members of staff. These appointments are additional to the present staff and arise from the rapid growth in the work of the College.

Salary scales: Lecturer, £1370 rising to £1550; Senior Lecturer, £1550 rising to £1750; plus in each case London Allowance of £38 rising to £51 at age 37.

Further particulars and forms of application are obtainable from the SECRETARY, to whom applications should be sent by 21st March, 1960.

B 438

NORTH STAFFORDSHIRE TECHNICAL COLLEGE

STOKE-ON-TRENT

PRINCIPAL: E. R. PATRICK, Ph.D., B.Eng., A.M.I.Mech.E., A.M.I.E.E.

ENGINEERING DEPARTMENT

Applications are invited for the appointment of a full-time ASSISTANT LECTURER GRADE "B" to commence in May, 1960, or as soon as possible thereafter. Applicants will be expected to teach subjects in the Ordinary National Certificate Course in Mechanical Engineering and should hold some recognised degree, certificate or other professional qualification. There is a possibility that the successful applicant may be asked to teach some subjects of the Higher National Certificate Course in Mechanical Engineering and in this connection the subject of Theory of Structures would be an advantage although not essential.

Salary in accordance with the Burnham Scale for Grade "B" Assistants: £700 0s. 0d. by £27 10s. 0d. to £1150 0s. 0d. per annum with full additions for training, graduate qualifications and experience, which may in some cases bring the maximum up to £1435 0s. 0d. per annum.

Forms of application may be obtained from the Principal, to whom they should be returned as soon as possible.

H. DIBDEN, Clerk to the Governors

B 404

PRODUCTION INSPECTORS

ADMIRALTY require temporary Production Inspectors with experience in either mechanical, electrical, electronic or marine engineering. Vacancies mainly in London, Bath, Portsmouth, Barrow, Glasgow and Newcastle. Work in connection with manufacture, inspection, test and installation of equipment in H.M. ships. Age at least 25, with recognised apprenticeship or equivalent training plus additional relevant experience with industry or Government Department. Candidates should possess H.N.C. or O.N.C. in mechanical or electrical engineering, or have reached at least equivalent standard of technical education with qualifications in appropriate subjects. Opportunities may occur later for permanency. Salaries: Assistant Production Inspectors Grade III, £700 at age 26 to £750 at age 28 to £875. Production Inspectors Grade II £875 at age 30 to £1035. Forms from Ministry of Labour, Technical and Scientific Register (K), 26 King Street, London, S.W.1, quoting D 115/0A. Closing date, March 11th, 1960. B 401

UNIVERSITY COLLEGE, DUBLIN

DEPARTMENT OF CIVIL ENGINEERING

Applications are invited for a temporary post as RESEARCH ASSISTANT in Civil Engineering. Salary £900 per annum.

Candidates should have a good Honours Degree and experience in design and construction. Special qualifications in Soil Mechanics would be an advantage.

Applications, accompanied by the names of two referees, to be sent to the SECRETARY, CIVIL ENGINEERING DEPARTMENT, UNIVERSITY COLLEGE, UPPER MERRION STREET, DUBLIN, on or before 11th March, 1960, from whom further particulars may be obtained. B 399

ALKALI INSPECTOR

MINISTRY OF HOUSING AND LOCAL GOVERNMENT

Five pensionable posts in Birmingham, Cardiff, Darlington, Liverpool and Sheffield for men at least 30 on March 1, 1960, with university degree in Science or Technology, or equivalent, and experience (at least 5 years) and knowledge of chemical or fuel technology and engineering and of related industries. Preference given to those who have achieved Corporate Membership of R.I.C. or I.C.E. Duties include administration of Alkali, etc., Works Regulation Act, 1906, to control emission to air of noxious fumes, smoke, dust, etc., from certain industries, and to ensure proper design, layout and operation of plant for this purpose. There is scope for initiative and individual responsibility. Considerable travelling involved, and candidates must be prepared to serve at any centre. National salary scale: £1160 (age 30)-£1730. Exceptionally starting pay may be above minimum. Promotion prospects.—Write Civil Service Commission, 17 North Audley Street, London, W.1, for application form quoting 8/5107/60. Closing date 22nd March, 1960. B 393

SHIFT CHARGE ENGINEER

SAO PAULO LIGHT S.A.—SERVICOS DE ELETRICIDADE, a Company in Brazil and a Subsidiary of the Canadian corporation Brazilian Traction, Light & Power Company Limited, invite applications from suitably qualified men for the position of SHIFT CHARGE ENGINEER in the Piratininga Power Station. The power station, put into service about five years ago, is situated near Sao Paulo (pop. over 3 millions, temperate climate, 2200 ft. above sea level). The plant comprised initially 2 by 80 MW, 1800 r.p.m. steam turbo-alternator units, each supplied at 850 p.s.i., 900 deg. F. by one 850,000 lb./hr. oil-fired boiler and is now being expanded by the addition of two 125,000 kW reheat units, 1800 p.s.i. 1000 deg. F. Applicants should have a sound technical knowledge and wide experience of the operation of modern turbines and boilers, preferably with oil or pulverised-fuel firing, should also have an aptitude for supervision and the maintenance of harmonious labour relations. Good salary, three years agreement with first-class passage both ways, with family; four months paid leave after three years' service.

Written application in the first instance should be made to MR. OSBORNE MITCHELL, GENERAL MANAGER, CANADIAN-BRAZILIAN SERVICES LTD., 9/12 CHEAPSIDE, LONDON, E.C.2.

B 384

STAFFORDSHIRE COUNTY COUNCIL EDUCATION COMMITTEE

STAFFORD COLLEGE OF TECHNOLOGY

PRINCIPAL: R. S. PARADISE, B.Sc. (Eng.) Hons., M.I.Mech.E., A.M.I.Mar.E.

Applications are invited for the following appointments:—

(*a*) SENIOR LECTURER in the DEPARTMENT OF MECHANICAL ENGINEERING

Candidates must be University Graduates, with teaching and industrial or research experience and should be prepared to teach to final degree and diploma level.

(*b*) LECTURER in LIBERAL STUDIES.

The successful candidate will be required to organise Liberal Studies throughout the College.

Salary in accordance with the Burnham Technical Scale for

Senior Lecturers ... £1550 by £50 to £1750
Lecturers ... ... £1370 by £35 to £1550

Form of application, returnable by 11th March, together with further particulars relating to the appointments may be obtained from the undersigned on receipt of a stamped addressed foolscap envelope.

J. H. P. OXSPRING,
DIRECTOR OF EDUCATION.

DEPT. F.E.,
COUNTY EDUCATION OFFICES,
STAFFORD.

B 437

WEST MIDLANDS GAS BOARD

ASSISTANT ENGINEER

CHIEF ENGINEER'S DEPARTMENT

Applications are invited from competent site engineers for the post of Assistant Engineer to oversee and control the erection of the new Lurgi complete gasification plant, which is being erected with ancillaries at Coleshill, Warwickshire, at a cost of £8,000,000.

Experience in supervising large contracts covering civil, structural and mechanical engineering will be an advantage, whilst Membership of the Institution of Civil Engineers or a similar body is desirable.

The salary for the appointment, which is pensionable and subject to medical examination, will be within the range of £1195 to £1355 per annum.

Applications, stating age, qualifications and experience, together with the names of two referees, should be addressed to the INDUSTRIAL RELATIONS OFFICER, WEST MIDLANDS GAS BOARD, 6, AUGUSTUS ROAD, EDGBASTON, BIRMINGHAM, 15.

B 434

UNIVERSITY OF LEEDS

DEPARTMENT OF CIVIL ENGINEERING

Applications are invited for two LECTURESHIPS in CIVIL ENGINEERING, at salaries on the scale £900 by £50 to £1350 (efficiency bar) by £75 to £1650 a year. Candidates should have had some practical experience and preference will be given to those with a special interest in at least one of the following subjects: Hydraulics, Surveying, Heating and Ventilation, Steelwork Design. Applications (three copies) stating date of birth, qualifications and experience, together with the names of three referees, should reach the REGISTRAR, THE UNIVERSITY, LEEDS, 2 (from whom further particulars may be obtained) not later than 1st April, 1960.

B 346

ASSISTANT ENGINEER

REGENT OIL COMPANY LIMITED requires ASSISTANT ENGINEER at their Bristol Office for work in connection with the maintenance and development of Oil Distributing Depots in the West of England and South Wales.

Qualifications required H.N.C. in Mechanical Engineering or Grad.I.Mech.E.

Age 25-30 years. Previous experience in Oil Industry preferable but not essential.

Salary in accordance with experience and background.

Life Assurance and contributory Pension Fund.

Details of education, technical qualifications and career in confidence to STAFF RELATIONS OFFICER, REGENT OIL COMPANY LIMITED, PRUDENTIAL BUILDINGS, WINE STREET, BRISTOL, 1.

B 413

APPOINTMENTS OPEN

ELECTRICAL ENGINEER

If you have a good honours degree in Electrical Engineering, are aged about 30 and would like to join the Commonwealth's largest glass manufacturing organisation, you are invited to write personally to Dr. W. L. Patrick, General Manager, Pilkington Brothers Limited, Kirk Sandall, Doncaster, where there is a £4,000,000 capital development programme.

You would be an assistant electrical engineer in a department responsible for the design and maintenance of a wide range of electrical equipment and instrumentation required for the supply and operation of large scale continuous processes.

Interviews are being arranged for the week commencing 14th March.

B 421

ENGINEERING EXECUTIVE

ENGINEERING EXECUTIVE with extensive experience home and export sales, preferably of heavy mechanical and hydraulic equipment, required to assist in general administration of medium-sized Company, Woolwich, London District; preferably within age group 24-40.—Full particulars of qualifications and experience to BOX B 405, Offices of ENGINEERING.

MECHANICAL ENGINEER

MECHANICAL ENGINEER. Opportunity occurs for Graduate or Corporate Member of the I.Mech.E between 35 and 40 years of age to assist in the Management of a large progressive old established mass production engineering works in the North Midlands. The Company is of international repute with several factories and produces a high precision product. Candidates must have had first class production experience, possess personality and tact and be capable of fitting into and taking part in the management and production administration of a large modern organisation. Good opportunity for a candidate who can measure up to the above requirements. Good conditions and pension scheme.

Reply, stating age and full particulars of experience and qualifications and salary expected to BOX B 409, Offices of ENGINEERING.

BRITISH INSTITUTE OF MANAGEMENT

REQUIRE A

PRODUCTION MANAGEMENT ADVISER

Successful applicant will probably have served an engineering apprenticeship and be a Member of the I.Mech.E. or I.Prod.E. Duties will be varied and extremely interesting. The post offers scope to a first class man who may wish to return to industry in about 4 years' time or to an older man as a permanency.

The work will cover management aspects of production control, planning, work study, maintenance and quality control; experience in one or more of these fields is essential.

Advisers have to provide information and advice to enquirers and are responsible for the content of courses and conferences on subjects related to production management. They will have the use and assistance of a library and Advisory Committee.

Starting Salary: £950-£1050. Pension Scheme. Applications to MR. N. GALLAGHER, HEAD OF MANAGEMENT SERVICES DEPT., BRITISH INSTITUTE OF MANAGEMENT, 80 FETTER LANE, LONDON, E.C.4. B 410

MECHANICAL AND ELECTRICAL ENGINEER

Mechanical and Electrical Engineer, aged 30/38, required to act as Assistant to the Chief Engineer of a large group of stadia. Knowledge of building construction an advantage. The position is pensionable and the salary will be commensurate with experience. Please write giving details of experience and academic qualifications to BOX B 403, Offices of ENGINEERING.

CHARTERED CIVIL ENGINEER

CHARTERED CIVIL ENGINEER required as Manager of expanding Department in a Contracting Company with international interests. Previous experience in office administration and estimating for and supervision of civil engineering contracts essential. This is an opportunity for a well trained man, preferably a university graduate, to build up a worth-while permanent career in an established Company, based in the provinces, with possibilities of a Directorship in due course. A substantial salary, bonus on results, expenses, car allowance and a Pension Scheme will be offered, along with a Company house at moderate rental and removal expenses. Candidates for this post are invited to apply in own handwriting (in confidence) for further particulars, also submitting a précis of their education, experience, availability, marital status and basic salary requirement, pending possible further enquiry from and interview with the advertisers.—BOX B 352, Offices of ENGINEERING.

ENGINEER

ENGINEER required to assist CHIEF MECHANICAL ENGINEER. Age 25-35, preferably with experience in Iron or Steel Works. A recognised qualification is desirable. The post is superannuated.—Apply in writing giving full details and qualifications to: LABOUR AND WELFARE OFFICER, STAVELEY IRON & CHEMICAL COMPANY LIMITED, NEAR CHESTERFIELD. B 349

GENERAL WORKS MANAGER

with prospects of early promotion to the Board)

for Medium-sized Engineering Company in London, to take charge of Production Departments manufacturing machines for Printing and allied trades and to give technical advice on the development of new products.

Applicants, aged 30-45, should be good organisers and have had experience with an Engineering Company manufacturing capital goods. A Mechanical Engineering Degree or equivalent is essential.

Starting Salary, £2000 per annum plus bonus—Pension Scheme, etc.

There are excellent prospects for an ambitious man to earn a seat on the Board and to grow with the Company, which has plans for expansion and the finance necessary to carry them out.

Please send full details, including age, experience and present salary, to BOX B 407, Offices of ENGINEERING.

ENGINEERING WORKSHOPS MANAGER

AN ENGINEERING WORKSHOPS MANAGER is required to be fully responsible for the Management of the Central Engineering Workshops of a large Integrated Steel Plant.

The Department employs about 650 men covering fabrication, welding, locomotive and wagon repairs, fitting and machine shops, etc.

The successful candidate should have the following qualifications and experience:

1. Engineering Degree or Associate Membership of the Institution of Production or Mechanical Engineers.
2. Several years' experience in supervision and management of a large Engineering Workshops in the medium to heavy engineering field.
3. Knowledge and experience of Production Engineering and modern management techniques.
4. Aged between 35 and 45 years.

A salary of at least £1700 per annum will be paid according to qualifications and experience.

Applications in writing giving full details of experience, qualifications and positions held should be forwarded to URWICK, ORR AND PARTNERS, LTD., ST. PAUL'S HOUSE, ST. PAUL'S STREET, LEEDS 1, quoting reference GM/1371 on the envelope.

B 416

"HEINZ"

LEADERS IN THE EXPANDING FOOD INDUSTRY OFFER THE FOLLOWING VACANCY FOR A:

JUNIOR MECHANICAL ENGINEER—aged 22-28, to assist the Manager—Mechanical Engineering in the administration of contracts placed for new projects throughout the Company, and other work normally handled by a Head Office Engineering Department. H.N.C. preferred, with some experience of project engineering for the process industries. This is a permanent and progressive position, offering considerable scope for the exercise of initiative.

Please write fully to the PERSONNEL OFFICER, H. J. HEINZ COMPANY LIMITED, WAXLOW ROAD, HARLESDEN, LONDON, N.W.10. B 417

STEEL WORKS PROJECT ENGINEER

An opening offering good prospects is available for a man of proved ability qualified in the layout and operation of Steel Works Plant and the co-ordination of requirements for Heavy Shears, Handling Equipment and Ancillary Gear, etc.

Applicants should be able to guide general designs to meet specifications and supervise the manufacture and building of complete equipments.

In the first instance please give full details of age, training and experience.—Write BOX B 400, Offices of ENGINEERING.

MECHANICAL ENGINEER

If you have a good honours degree and Corporate Membership of the Institution of Mechanical Engineers, are aged about 35 and would like to join the Commonwealth's largest glass manufacturing organisation, you are invited to write personally to Dr. W. L. Patrick, General Manager, Pilkington Brothers Limited, Kirk Sandall, Doncaster, where there is a £4,000,000 capital development programme.

You would be considered for a managerial position with a view to being appointed deputy mechanical engineer in a year's time with positive prospects of further early promotion. You would be required to organise the construction, maintenance and development of highly mechanised continuous process plants presenting many varied and novel problems in all aspects of mechanical engineering.

Interviews are being arranged for the week commencing 14th March.

B 420

LOTUS LTD. STAFFORD

WORKS ENGINEER

There is a vacancy at the Stafford shoe factory of LOTUS LTD. for a WORKS ENGINEER to take charge of all aspects of factory maintenance. Experience of installing and maintaining production machinery is essential, together with a practical knowledge of electrical and building trades work and all the normal works services. This is a staff position, carrying a salary commensurate with the responsibilities involved, and offers good prospects for the future.

Please apply by letter giving complete details of education, qualifications and experience together with an indication of present earnings, to the PERSONNEL MANAGER, LOTUS LTD., SANDON ROAD, STAFFORD. B 386

MECHANICAL ENVIRONMENTAL TESTING

THE ATOMIC WEAPONS RESEARCH ESTABLISHMENT, ALDERMASTON, BERKSHIRE.

require staff to work in this interesting field.

The posts offer scope for original thought and the development of new ideas and would be of interest to Mechanical or Electro-Mechanical Engineers or Physicists.

Candidates should have a Pass Degree or H.N.C. together with experience of Research and Development work.

SALARY: £1045-£1285.

Contributory Superannuation Scheme. A house, or substantial assistance with house purchase, will become available for married officers living beyond daily travelling distance.

POSTCARDS for application forms to the SENIOR RECRUITMENT OFFICER at above address. Please quote ref. 2544/26. B 391

T. I. (GROUP SERVICES) LIMITED

(The Service Company of the Tube Investments Group)

A number of vacancies are available in the Plant Development Department of the above company for experienced

DESIGN ENGINEERS

The work of the department includes a wide range of plant design, development of prototype machines, factory planning, progressing installation programmes, etc.

PROMOTION

Excellent opportunities exist for promotion to responsible positions in the manufacturing companies of the Group. Pension Scheme and Life Assurance Scheme. Social Club facilities.

Applications are invited from men 28-35 years of age with experience in the design of special purpose machines and having as a minimum qualification Higher National Certificate or the equivalent. They should be sent, giving full details of qualifications, experience, present salary, etc., to the

PERSONNEL MANAGER, T I. (GROUP SERVICES) LIMITED, ROCKY LANE, ACTON, BIRMINGHAM, 6.

B 427

DESIGN ENGINEER (INSTRUMENTS)

required by the

UNITED KINGDOM ATOMIC ENERGY AUTHORITY (PRODUCTION GROUP)

Springfields Works, Salwick, Preston, Lancashire, to be responsible to a "Senior Engineer" for the design and layout of instrumentation for chemical and metallurgical processes. Duties will include supervision of instruments design staff, preparation of specifications for purchase of equipment, and technical advice to construction staff employed on building projects. A wide range of physical, pneumatic, electronic and electrical instruments is involved.

A recognised engineering apprenticeship or comparable training and corporate membership of a senior engineering institution, or equivalent, are essential. A good knowledge of instrumentation for the measurement, recording and control of liquid and gas flow, temperature and pressure, familiarity with automatic control systems, together with wide experience of design work in the instruments field in relation to chemical and metallurgical processes, are also required.

Salary between £1370 and £1825, according to qualifications and experience.

Contributory Superannuation. Staff Housing Scheme.

Send postcard for application form, quoting reference SF.27/J2, to Works Secretary, at above address.

Closing Date: 7th March, 1960.

B 390

AEI

ASSOCIATED ELECTRICAL INDUSTRIES LIMITED

SENIOR MECHANICAL ENGINEER

The Large Electrical Machine Engineering Department of the Heavy Plant Division in Manchester require a Senior Mechanical Engineer. This is a responsible position concerned with the mechanical design and development work involved in the electrical design of large rotating plant for hydro-power stations and general industrial applications. A laboratory is available to facilitate experimental work.

It would be desirable for applicants to have had previous experience of this type of work, but a first class engineer, with sound mechanical knowledge would be favourably considered. It is expected that persons possessing the required background would be aged 30 years or over.

QUALIFICATIONS: Applicants should have served a recognised engineering apprenticeship and preferably hold a degree in Mechanical Engineering. They should be at least an Associate Member of the Institution of Mechanical Engineers.

Please write for application form quoting reference O.14 to:—

The Personnel Manager
Associated Electrical Industries (Manchester) Ltd.
Trafford Park · Manchester, 17

B 389

MECHANICAL ENGINEER

Graduate Mechanical Engineers with mathematical ability are invited to apply for a position in the mechanical section. The work involves solution of specialist problems associated with Piping Design and includes Piping Flexibility and Stress Analysis, Structural Vibration Analysis and Analysis of Pulsating Fluids in pipeline systems. Applicants should have a university degree in Mechanical Engineering and preferably two years' experience in industry. Salary will be commensurate with qualifications, experience and capabilities. Comprehensive personnel benefits include contributory pension scheme, luncheon vouchers, excellent working conditions and social club.

Please write to Mr. R. H. Paterson

KELLOGG INTERNATIONAL CORPORATION

7-10 CHANDOS STREET · LONDON, W.1 B 392

JOHNSON, MATTHEY & CO., LIMITED

DESIGN ENGINEER

Aged 23-33, with good drawing-office background, is required for the Chief Mechanical Engineer's office in Central London. A sound practical training and knowledge of engineering services is essential.

The work entails handling projects from the drawing-board through to construction and running in for production.

Conditions of service include free lunches and an annual bonus, also a contributory pension scheme.

Write, giving full details of age, qualifications, experience, etc., to the Secretary, JOHNSON, MATTHEY & CO., LIMITED, 78, HATTON GARDEN, LONDON, E.C.1. B 426

METALLURGICAL CHEMIST

is required by

W. H. ALLEN SONS & CO. LTD.

to take charge of the Chemical Section of the Metallurgical Laboratory at their Queens Engineering Works, Bedford. Applicant should possess at least H.N.C. and have experience in ferrous and non-ferrous analysis. A knowledge of corrosion and works processes, i.e., electro-plating, an advantage. The work, which is varied and interesting, includes the training of junior staff. (Ref. 1601/D1/3,)

METALLOGRAPHER

is also required

to take charge of a Section of the abovementioned Laboratory dealing with micrography and photography, including the investigation of unusual service failures. A knowledge of works processes, such as welding, metal spraying, hard surfacing, etc., would be an advantage. Ability to write clear and concise reports essential. (Ref. 1601/D2/3.)

Permanent appointments with a good Staff Pension and Life Assurance Scheme.

Apply, stating age and experience (quoting reference number), to the PERSONNEL MANAGER, W. H. ALLEN SONS & CO., LTD., BEDFORD. B 350

UNIVERSITY OF LONDON KING'S COLLEGE

LECTURER OR ASSISTANT LECTURER IN CIVIL ENGINEERING

Applications are invited for this post. Candidates should have a good Honours degree, some experience of teaching and/or research and professional experience is also desirable. The salary for an Assistant Lecturer is on the scale £700 by £50 p.a. to £850, and for a Lecturer £900 by £50 p.a. to £1350, then by £75 p.a. to £1650. The starting point will be according to qualifications and experience. A London allowance of £60, family allowances and F.S.S.U. benefits will also be payable.

Conditions of appointment and application forms may be obtained from the REGISTRAR, KING'S COLLEGE LONDON, STRAND, W.C.2. Completed forms must reach him by 16th March. B 362

SENIOR DESIGN DRAUGHTSMAN

required with experience of Industrial Heating Furnaces as used in the iron and steel industry. Life Assurance and Contributory Pension Scheme.

Write to the

Chief Engineer, Appleby-Frodingham Steel Company, Scunthorpe, Lincs.

stating age and giving full details of experience. B 436

TECHNICAL ASSISTANT

IMPERIAL CHEMICAL INDUSTRIES LIMITED has a vacancy for a TECHNICAL ASSISTANT for its Standards Section in London for work relating to engineering plant and general stores equipment. Candidates must hold the Higher National Certificate or equivalent qualification and have had practical and drawing office experience. As the duties of the post include liaison and committee work candidates must have first-class personal qualities and be able to express their ideas clearly and concisely.—Applications giving age and experience should be made to HEAD OFFICE STAFF DEPARTMENT (GDC), IMPERIAL CHEMICAL HOUSE, MILLBANK, LONDON, S.W.1. B 439

ENGINEER

Major industrial company requires an engineer at one of its North London Works. Applicants should have a good engineering background and preferably some experience in development work in a Process Industry. He will act as an assistant to the Engineering Manager and would be required to work both on new projects and modification of existing plant. Minimum qualification of Higher National Certificate and the age range is 24-30; an attractive commencing salary and there are bright prospects for the future.—Please reply to BOX B 433, Offices of ENGINEERING.

APPOINTMENTS WANTED

GRADUATE MECHANICAL ENGINEER

Experienced graduate mechanical engineer, 47, seeks position, continental languages, would travel, based London.—BOX B 415 Offices of ENGINEERING.

B.Sc., M.I.Mech.E., Public School, Scot, aged 53, at present Managing Director in India controlling extensive group of engineering companies and well known agency interests; returning West of Scotland April, 1960, seeks position of interest and responsibility—salary secondary consideration.—Write 1921, WM. PORTEOUS & CO., GLASGOW. B 441

PILKINGTON BROTHERS LIMITED

GLASS MANUFACTURERS

SENIOR DRAUGHTSMEN

are required at Cowley Hill Works to work on the design and installation of new plant and associated services.

Applicants should have at least Higher National Certificate and have had considerable experience on the design of special purpose heavy machinery or of general plant layout.

The position offers good prospects of promotion. The Company provides assistance with house purchase.

Applications should be addressed to the **WORKS PERSONNEL OFFICER, PILKINGTON BROTHERS LIMITED, COWLEY HILL WORKS, ST. HELENS, LANCASHIRE** B411

ENGINEERING DRAUGHTSMEN AND ENGINEERS

ALL GRADES OF ENGINEERING DRAUGHTSMEN AND ENGINEERS required immediately. High starting salary.—Please Phone AMB 8189. B 424

WORKS' ENGINEER

Applications are invited for the position of a "WORKS' ENGINEER" with A.M.I.Mech.E. and must have Electrical knowledge up to H.N.C. Experienced, to control and supervise hydraulic/mechanical and electrical services in London works manufacturing non-ferrous metal rods, tubes, sections, wire and forgings. Age preferably 35/40. Excellent prospects of advancement, good salary and pension scheme.

Write: WORKS DIRECTOR, THE DELTA METAL CO, LTD., DELTA WORKS, TUNNEL AVENUE, EAST GREENWICH, LONDON, S.E.10. B 402

'Engineering' Appointments Section

ADVERTISEMENT RATES

CLASSIFICATIONS: Public Appointments, Appointments Open, Appointments Wanted.

TYPES OF ADVERTISEMENTS:

(a) "Appointments Illustrated" and illustrated careers advertisements: photographs or drawings may be used in conjunction with type matter.

Rates:	per page (12 in. by 9 in.)	£100
	half page	£54
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Rates:	per page (12 in. by 9 in.)	£100
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BLOCKS: To be mounted ready for printing. Screen 100.

ORDERS TO: "Engineering" 36, Bedford Street, London, W.C.2. (Telephone TEMple Bar 3663).

Companies

Southampton to Severn Chemical Pipeline

IMPERIAL CHEMICAL INDUSTRIES are to start building the first plant this Spring on their thousand acre site at Severnside in Gloucestershire. The raw material for the plant, which is to make ethylene oxide, ethylene glycol and linked products, will be large quantities of ethylene supplied from Esso's refinery and chemical plant at Fawley, 70 miles south-east at Southampton.

The ESSO PETROLEUM Company is planning to supply the ethylene by underground pipeline. If permission is given, the cost of the pipeline will be about £800,000. A much longer pipe from Fawley to the London Airport area for petroleum products will cost Esso, it is believed, some £2,300,000. The chemical pipe would be at a depth of not less than 30 in, passing under railway lines, roads, rivers and canals.

Both companies are spending about £5 million each on plant developments at the Fawley and Severnside sites. Esso will be adding ethylene, butene and propylene plant which should be ready to go into production before the end of next year. It is a reasonable deduction from the fast expansion of the oil importers into major sources for the British chemical and plastics industries that an anti-oil policy will have less and less chance of success in Britain, unless the scientists of the National Coal Board became as adaptable as those of the oil industry.

The opening of the Severnside site is the first stage towards the creation in the South-West of an equivalent to North Yorkshire's "chemical town" at Billingham, where ICI has invested more than £100 million since 1949.

Steel Firms Cooperate

The IRON AND STEEL BOARD's agreement to a revised fourth development plan for the STEEL COMPANY OF WALES reduces the capital cost from £33 million to £20 million. The new plan provides for the rolling of SCoW slabs from the Abbey Works, Port Talbot, in the hot mill under construction for the new Spencer Works near Newport, Monmouthshire, for the still nationalised RICHARD THOMAS AND BALDWINS.

The agreement between the two companies is to run for at least five years. The hot rolled steel coils will be returned to SCoW for conversion into steel sheets and tinplate.

The new SCoW plant, increasing its steelmaking capacity from 3 million to 3·6 million tons a year and its sheet and tinplate production by 400,000 tons a year, is expected to come into production at more or less the same time as RTB's hot strip mill.

The Iron and Steel Board have also given permission for COLVILLES to extend their earlier strip mill proposals. The new scheme will raise output from 230,000 tons of sheet a year to 500,000 tons.

The Board now estimates that total demand in the United Kingdom for steel sheet and tinplate in 1962 will be 4·6 million tons, and that productive capacity including all the new schemes now in hand will be 6 per cent ahead of demand, at 4·9 million tons. By 1965, the Board believes, demand will have lifted only slightly, to 5·3 million tons but capacity will be 16 per cent ahead, at 6·1 million tons.

Lively Time Ahead for Harper

Immediate prospects of further amalgamation announcements and the prediction of a threefold rise in the trading profits presage an excellent year for HARPER ENGINEERING AND ELECTRONICS.

Mr. N. C. Weaver, chairman of Harper, in his annual statement, describes the state of the order book, of current earnings and of future prospects as "highly satisfactory." The company's more recent acquisitions include SAMUEL PLATT Limited and Exeter and Plymouth airports.

In the year ended 30 June, 1959, the group's turnover was £2,211,329 and the trading profit £251,635. For the year which the company is now half way through Mr. Weaver predicts a final group trading profit of about £700,000, on a turnover which should be more than £4,500,000.

Shipping Round the Corner?

The shadow of unemployment and unused yards hangs unrelieved over the shipbuilders but there is now a little evidence that for some companies the worst of the slump in shipping freights may be over.

The annual review of the P AND O GROUP shows how "the depressed levels" prevailing in 1958-59 cut the profits of the group (after tax) from £6,647,000 to £3 million. Since freight rates are said to be 10 to 15 per cent above the lowest levels of 1958-59 it is reasonable to foresee a better result being turned in by P and O for the current year. There hardly seems to be any sufficiently substantial recovery to justify hopes of an improvement in the order book situation at the yards.

The P and O chairman, Sir William Crawford Currie, flatly declares: "It is impossible to say whether these more encouraging trends will continue."

The P and O Group subsidiary ORIENT Line suffered considerably more at the hands of the depressed market. Operating profit, despite transfer of £189,000 from reserve, fell from over £1 million to £431,000.

Tube Investments To Raise £21 Million

New capacity for tube and electrical equipment production, a large new steel project, overseas investment and the need for more capital as production steadily rises, these are the reasons for TUBE INVESTMENTS setting out to raise £21 million from its shareholders.

Sir Ivan Stedeford, the TI chairman, made the point last December that "It takes much longer to regain lost momentum that it does to lose it."

The company intends to make the most rapid progress possible in its capital schemes. Plans are under consideration for the aluminium interests of TI, which bought British Aluminium last year, to raise further capital themselves.

Whatever the Set-Up

An important aspect of the policies of LEYLAND MOTORS Limited, not touched on in these columns last week, was the overseas investment by Leyland in companies building, assembling or marketing the group's vehicles.

Sir Henry Spurrier, the Leyland chairman (inset) referred in his annual state-

ment to the interest he has taken in the formation in Europe of the Common Market, and more recently the Outer Seven.

"We are determined," he said, "to place ourselves in a position whereby we can continue to do business whatever the set-up may be."

This determination has led to Leyland investment in companies in Denmark, Holland and Belgium. It is not surprising that Sir Henry urges the Outer Seven countries eventually to amalgamate their trading area with the six Common Market nations.

Leyland now have an interest in the state owned Spanish motor organisation ENASA and Sir Henry and two other directors of Leyland have been elected to serve either on the ENASA board or on the controlling technical committee.

In a market likely to produce rather more rapid results than Spain—the United States—Leyland's strategy has been to form a joint company—LEYLAND MOTORS (USA) Incorporated—with JAGUAR CARS. The Jaguar firm has an enviable reputation for sales and service in the United States and the new joint subsidiary will benefit directly.

Lancashire Dynamo Battle ends

ELECTRIC AND MUSICAL INDUSTRIES' withdrawal of its offer for the capital of LANCASHIRE DYNAMO was swiftly followed by the statement of Mr. John Black, deputy chairman of the victorious METAL INDUSTRIES, who said: "I have always maintained that there is a natural link between Metal Industries and Lancashire Dynamo. By coming together we shall be in a position to provide industry with the most complete and advanced techniques in automation."

EMI withdrew from the struggle after Metal Industries had bought actively on the Stock Exchange and the price of Lancashire Dynamo stock had risen to a point where Metal Industries were paying an average of rather more than £4 a share for the substantial proportion of the company's shares they were buying.

Mr. Black, paying tribute to the record of the various Lancashire Dynamo companies, said it was their intention to give every support to the management and workpeople who had built up the firms. Pension rights and other benefits of the Lancashire Dynamo employees would be maintained.

Serpent-Barges Have New Company

Dracone, the commercial successor to the sea serpent, now has its own company for the commercial launching throughout the world of these flexible barges, first developed by Cambridge University engineers.

The company is DRACONE OPERATIONS Limited. It has the backing of associates of HAMBROS Bank and of the shipbrokers, H. CLARKSON and Company. DRACONE DEVELOPMENTS, part of the National Research Development Corporation, which sponsored the early life of the highly adaptable Dracone, will continue in being and is associated with the new company.

Professor W. R. Hawthorne, one of the engineers who thought up the Dracone, is on the board of the new company. Its chairman is Admiral Sir John Eccles.

Dracone Operations is now associated in the making of the long, sausage-like barges with P. B. Cow, who among other things produce Lilo air-beds, and with the FRANKENSTEIN-BEAUFORT Organisation, of Manchester, who include high altitude and survival clothing among their interests.

The list of those who have taken part in successful tests with Dracones, the word comes from the Greek for serpent, numbers ESSO PETROLEUM, IMPERIAL CHEMICAL INDUSTRIES, and the Army.

The skin of the flexible barge is made of woven nylon, proofed inside with Acrylonitrile rubber and coated outside with Neoprene. Petroleum products have no effect on the inner lining.

Because of its ability to give to obstacles the skin has high resistance to abrasion, chafing and to landing on sand, pebbles and even rounded rocks.

Not only petrol products and liquid chemicals are being carried by Dracone in the UK, Africa and the Far East, but cargoes of rice and grain.

Cost and running expenses of the sausage-barge are less than those of conventional steel barges. The cost of moving an empty 250 ton steel barge from Europe to West Africa is stated by the company to be about £3,000 and that of a 320 ton Dracone from Britain to West Africa to be £450.

Moving the empty Dracone is cheap because it can be folded up for transport by rail or lorry, or wound up on a reel.

An 80 per cent loaded Dracone has a draught of only 4 ft.

The points that are likely to speed the acceptance of the improbable looking Dracone in many ports is absence of corrosion, a considerable factor in maintenance calculations. Since there is no air space inside the skin it is not likely to harbour explosive gas-air mixtures. The special skin means that it can be moored alongside tankers without risk of causing fires by friction.

The Dracone has two particular advantages in manoeuvre. When under tow the "snatch" loads and the steady load are less than with a normal steel barge. When being used in a narrow waterway the Dracone can be turned round in the equivalent of a taxi driver's "U" turn.

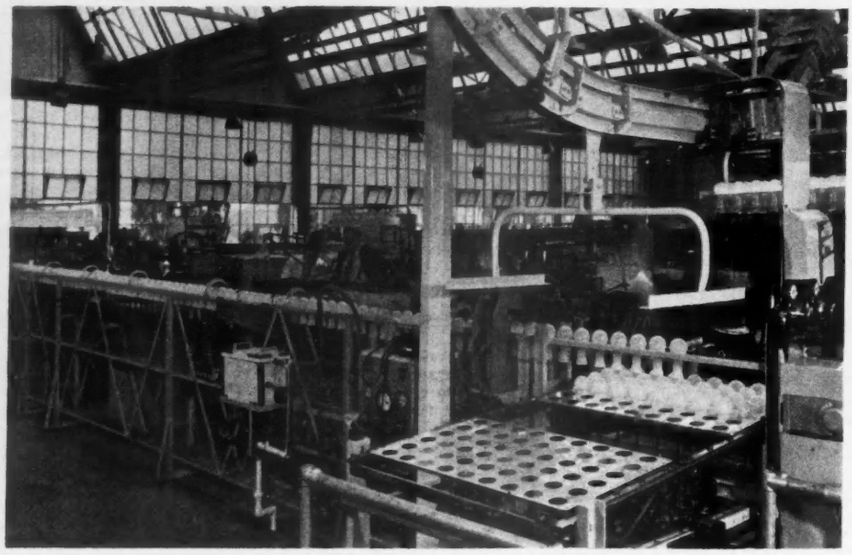
Automatic Conveyor for Glass Bulbs

A new system for the automatic conveying of bulbs has been installed at the Osram Lamp Works at Wembley. The system can carry 20,000 bulbs per hour from the ground floor of the factory to the top floor where the lamps are made, a distance of 250 ft. It is reported to save labour and space, and it cuts down breakages.

In the first instance, the conveyor system has been designed to serve ten production groups for general lighting service lamps at Wembley. Each group is fed with bulbs to be used in making lamps and the handling of them has, in the past, involved a great deal of manual labour. They were unloaded from cartons, fitted into trays, and washed and dried. They were then taken by trolley and lift to the production group. Finally, they were imprinted on the crown with the lamp rating and other details. All this involved four separate manual operations—each requiring many operators.

In the new system, an operator first unpacks, inspects and loads the bulbs into trays. After this, the bulbs are not touched by hand again until they have been made into lamps.

On the lower floor, trays are placed on ramps sloping down towards an overhead conveyor. There are ten ramps, each one associated with a machine group on the production floor above. Hangers on the conveyor pass in front of these ramps, every tenth hanger feeding one particular group. At the right moment, a pneumatic lift, triggered by the control system, raises the tray from the bottom of its ramp and places it in position to be taken up by its hanger. The hanger carries the tray to the upper floor where another control trip deposits the tray on a transfer unit at the right production group. The same hanger takes off an empty tray and returns it to the lower floor for reloading. In this way, the bulbs required on a particular group are loaded on to the appropriate ramp downstairs, and are delivered only to the group for which they are intended. Each group may be using different bulbs. They are all carried on the one conveyor but are automatically distributed to the correct group.



The automatic imprinting and bulb washing plant.

A full tray accepted by a machine group carries 54 bulbs in rows of nine. The tray rolls down another ramp, and row by row the bulbs are removed to the transfer unit where they are first stamped by an automatic printing machine. They are then washed internally by clean hot water, dried by heated compressed air and finally loaded on to a sealing-in machine where they meet the other components required to produce finished lamps.

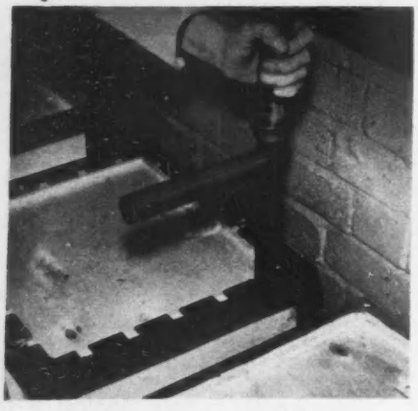
The conveyor feeds bulbs to the groups at a slightly faster rate than required, so that a group never has to wait for supplies. When the production group has as many bulbs as it can cope with, a control system is so arranged that the next full tray is not deposited from the conveyor, but carries on and is eventually brought round again for acceptance. This would also happen if the machine group were stopped for any reason.

Besides saving labour and space and reducing the number of broken bulbs, the system has another important advantage. Clean hot bulbs arrive at the processing machines. There are no troubles with dirt and condensation on the inside of the glass which occurred before when the washed and dried bulbs were standing around waiting delivery by hand. This was inclined to happen when, for example, the production machines were shut down for weekends.

High Speed Closing of Plywood Cases

A task which formerly took a three-man team four hours to complete is reported to be performed now by one man in one hour, following the development of a high speed method of packaging by the Champion Sparking Plug Company Limited of Feltham. The system features the use of plywood export cases produced by Venesta Plywood Limited.

This has been achieved by the aid of a welded angle-iron sealing frame designed by Champions, which is placed over the top of a case before it is stapled. Notches cut at regular intervals around the inside edges of the frame ensure that the staples are inserted at uniform points along the top edges of the lid.



A frame in position on a case.

Before the new method was adopted, three men were permanently employed in the duty of closing and sealing the softwood cases then in use. On a good day, the team could complete 10 cases an hour. Now one man can complete up to 40 an hour. The use of softwood cases involved considerable work and imposed severe restriction on the method of packing employed. All sparking plugs produced in the factory, whether for home distribution or export, were placed into cardboard cartons which, in turn, were put into large corrugated board boxes. They were then transferred by conveyor belt to the dispatch department to await delivery. It was here that so much time, labour and materials were wasted in dealing with export orders.

Whenever an overseas consignment was made up, it was necessary to pack the plugs into a more substantial container than the corrugated boxes. This meant that the various plugs required had all to be unpacked from the boxes, and repacked into the heavy softwood cases which were than nailed, wired and stapled by the three man team.

In the new method, all cartons of plugs required for export orders are placed directly into the Venesta cases direct from the filling point in the factory. The loaded cases are placed on to the conveyor belt, and travel with the box-packed plugs for the home market to a point where the different containers are divided and directed at right-angles along separate belts moving in opposite directions along one wall of the dispatch department. This division ensures that the right container arrives at the right spot for the next operation. In the case of the corrugated boxes, this involves storage in pallet racks until they are needed for making up into orders. The plywood cases, on the other hand, roll to a point where they are close sealed and stencilled.

The frames designed by Champions are made in the form of hollow rectangles a little larger than the length and width of each of the eight sizes of case used. Welded all round the top edge of each frame is a lip from which is cut a series of rectangular notches. As the cases reach the sealing point, an operator puts on a lid from a stock supply and bends the metal edging on the case inwards and downwards towards the lid. The appropriate size frame is then fitted over the top of the case and hammered securely all round into position. This action has the effect of quickly pressing the metal flat to the lid and creating a clean, straight edge free of dents and burrs which might otherwise be caused by direct hammering. An automatic stapler, fitted to a boom, is then swung over the case and the staples inserted at the spaces provided.

Vacuum Furnace for Research

The General Electric Company Limited, in association with Vacuum Industrial Applications Limited, has received an order for the supply of a vacuum melting furnace to the British Iron and Steel Research Association for use in their Sheffield laboratories.

The furnace has a melting capacity of 56 lb and is to be used for research into the vacuum melting and casting of ferrous metals. The working pressure of the furnace is 1 micron of mercury and it is designed for a working temperature of 1,700° C. The charge is poured into the moulds by tilting the crucible. The 2 ft diameter furnace chamber is horizontal to provide ample working space and to permit easy cleaning of the inner surface. Within the chamber are dip thermocouples for temperature measurement, and also six tipping buckets for adding alloying metals to the molten charge.

The chamber is evacuated by means of a two-stage pumping system comprising a 10 in oil booster-diffusion pump backed by a gas ballasted rotary pump. The pumping speed of this combination is high enough to maintain the vacuum under conditions of severe outgassing. The charge is induction heated and power for the furnace is supplied by a 10 kc/s motor alternator.

Vibrating Screens with Many Uses

Overstrom Screens, among the most successful vibrating screens produced in the United States, are being manufactured under licence by Armstrong Whitworth (Metal Industries) Limited of Gateshead. The screens are reported to be suitable for installation in mines, quarries, chemical works, granaries, oilfields and potteries. They are built for wet or dry, light, medium and heavy service.

There are seven sizes of screen available ranging from 3 ft by 1½ ft to 16 ft by 6 ft, and each can be equipped with one, two or three decks. All screens can be fitted with partial or complete dustproof enclosures, water spray equipment, and heating units which are sometimes required for the finer mesh decks dealing with damp, sticky materials.

The first British-made screen is now being installed at Kirkwhelpington, working in conjunction with a large Kue-Ken crusher also manufactured by Armstrong Whitworth. This particular screen is an 8 ft by 4 ft single deck assembly with a 2½ in square mesh for screening quartz-dolorite.

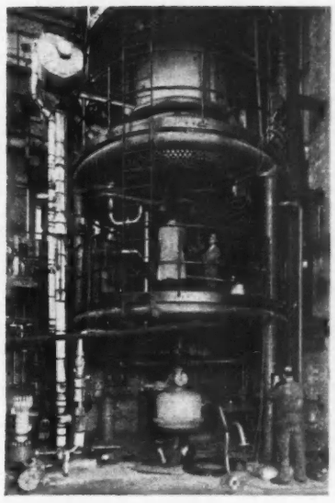
Total Gasification of Low Grade Fuels

A pressurised coke gasifier is being developed at Leatherhead by the gasifier division of Constructors John Brown Limited, as part of the Ministry of Power investigations into more efficient and economical means of producing gas from run-of-mine coal.

The fixed-bed continuous gasification system is characterised by the fact that it combines a high operating temperature with a high pressure. At present, the development gasifier is operating at pressures up to eight atmospheres absolute, although it is thought that in time gasifiers of this type will be capable of working at pressures of up to 31 atmospheres.

In the gasifier, coke, which is used to avoid problems arising from the volatile constituents of coal, is reacted with a mixture of oxygen and superheated steam to produce synthesis gas, a carbon monoxide and hydrogen mixture which is a suitable basis for the synthesis of hydrocarbon fuels. It is expected that a production gasifier of this type would be able to generate synthesis gas at a substantially lower cost than is possible using current methods. When this ideal is realised, the gasifier's ability to convert all types of mined coal, together with it low gas cost, will make it attractive as a means of supplying town gas and of making synthetic fuels and chemicals.

So far as town gas is concerned, the potential



The experimental coke gasifier. The cooling system and the slag dispersal system are based on the use of pressurised water circulated by Megator pumps.

lowering of capital costs is an attractive possibility. The need for low pressure would be diminished, and the number and size of gas production units considerably reduced.

High-Strength Light-Gauge Titanium Sheet

Development of a superior heat treatable titanium sheet alloy along with a new process for heat treatment have been announced by the Republic Steel Corporation of Cleveland, Ohio. The new heat treated titanium sheet is described as particularly attractive in the aircraft industry, since it can be used in thinner gauges, and therefore lighter weight, while still holding to required strength ratings. The alloy is identified as type RS-140 and it contains 5 per cent aluminium, 1·25 per cent iron and 2·75 per cent chromium.

The new process for heat treating large titanium is reported to make it possible to produce heat treated titanium alloy sheet free of surface contamination with better flatness and more uniform properties than ever before.

For its new heat treatment process, Republic Steel is using a five zone electrically heated continuous roller hearth furnace. especially adapted to deliver uniformly heated sheets directly into a continuous roller quenching unit. The furnace is described as providing for a high degree of uniformity of heating, with temperature control in each zone of plus or minus 10° F.

During the process, titanium sheets which have been specially precoated to prevent contamination by atmospheric gases are heated for short periods at a temperature of between 1,400° F and 1,700° F depending on alloy grade. This is followed by water quenching in a continuous roller quenching unit.

After treating, the sheets are in a soft condition and may be either hot or cold formed, then aged for several hours at a temperature between 900° and 1,000° F to produce high strength levels. Alternatively, it is explained, the sheets after solution treating may be aged at the mill, then shipped in the fully aged condition for applications where only moderate forming is required, but where high strength is necessary in the final part.

Use for Waste Products of Power Generation

Thermalite Ytong Limited, the producers of precast aerated concrete, recently announced the construction of two new factories which are to come into operation early in 1961. One of them will be at Manchester and the other in the Greater London area. The company already claims to manufacture 95 per cent of all high pressure steam-cured aerated concrete produced in this country at their factories in the Midlands, half-way between Birmingham and Coventry, and in the south at Reading.

With the coming into operation of the new factories, which are so designed that production can be doubled and re-doubled within a short period, net productive capacity will be five times that of 1958. Over 75,000 tons of pulverised fuel ash, a waste product of solid fuel power stations, the disposal of which represents a major problem to the Electricity Authority, will be consumed annually in the production of Thermalite. This is equivalent to the total annual output of pulversied fuel ash from two medium-sized power stations.

More Sulphuric Acid Plant

A sulphur burning contact sulphuric acid plant has recently been commissioned by Chemical Construction (G.B.) Limited at the Billingham, County Durham, works of British Titan Products Company Limited. This latest addition to the sulphuric acid plants of British Titan Products is one of the two largest in Great Britain. The plant has a design capacity of 250 tons per day using sulphur as raw material and produces sulphuric acid at 98 per cent concentration. The plant has currently been producing acid at a rate of about 300 tons per day.

Incorporating some novel features, the plant is of the most modern design. Sulphur is melted in steam heated tanks and is pumped into the sulphur furnace by way of two Chemico spray burners each handling around 45 tons per day. The contact section uses a LaMont waste heat boiler for heating the sulphur dioxide gas and raising steam. The plant is equipped with a Chemico hot gas filter of novel design placed after the boiler and economiser. The filter is designed to enable a rapid change of the filter medium without an extended shut-down. It is estimated that a complete changeover may be made in under four hours while the plant is still hot. The blower room, pump room, and control room are all located under the tower structure.

This latest plant brings British Titan Products, total sulphuric acid capacity at both Grimsby and Billingham to over 1,000 tons per day.

Rolling Aluminium and its Alloys

James Booth Aluminium Limited has ordered the first part of its £5 million re-equipment and expansion programme. The subject of the order is the largest rolling mill of its type in Western Europe, and it is expected to be in operation in the company's Kitts Green works in Birmingham during 1961.

The mechanical side of the plant, has been ordered from the Loewy Engineering Company Limited in Bournemouth, and is designed to roll aluminium and Duralumin slab ingots weighing up to six tons, for the production of plate, sheet and strip. Included in the plant is a reversing 4-high hot mill 148 in wide. As well as providing much larger sizes of aluminium alloy plate particularly to meet the growing demands of the shipbuilding, chemical, aircraft and atomic energy industries, the new plant will greatly augment the production capacity for all flat rolled products.

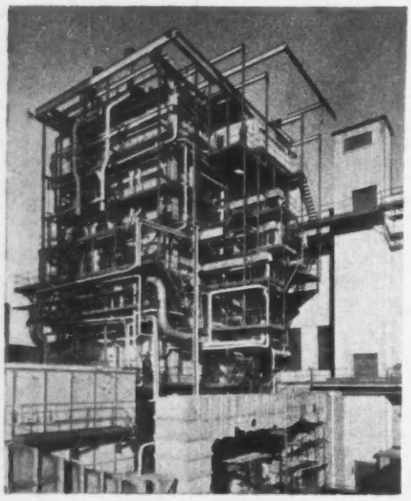
Transducers Control a Power Station

Little Barford "B" power station of the Central Electricity Generating Board has unusual operational features that include instrumentation and automatic boiler control based on an electronic system.

When Little Barford "A" power station, near Bedford, was built in 1942, it was equipped with four 30 MW generating units, and a second station (Little Barford "B") was envisaged, to double the capacity by means of two 60 MW units. Work on the new project was held up by the war and by capital expenditure restrictions, and the "B" station is only now completed.

In general design and layout the "B" station, which, like the older one, is arranged for coal firing, is conventional, but several unusual features have been incorporated, giving both constructional and operational advantages.

There are two 60 MW two-cylinder turbo-alternators, built by C. A. Parsons and Company Limited, and so arranged that they form, with their associated circulating water system, cooling tower, instrumentation and boiler, a complete operating unit. Generating at 11·8 kV, which is stepped up to 132 kV by generator transformers, the turbo-alternators are hydrogen cooled at 15 lb per sq. in. They are installed in a turbine room 245 ft long and 117 ft wide, which is open on one side to the boiler firing faces, and is particularly spacious and well laid out for accessibility to all items of plant for maintenance. Condensing and feed water heating are by conventional means.



Both the boilers at Little Barford "B" power station are in the open, except for the firing faces.

The boilers, by Foster Wheeler Limited, are both single drum units of 550,000 lb per hr capacity at 950 lb per sq. in and 910° F, and are of outdoor construction except for the firing faces and the coal pulverising mills and ash handling equipment—the latter items being installed in an enclosed basement. By using this type of construction, which is widely applied at oil refineries and other industrial plants, there was a considerable saving in the cost and time of erection and, of course, the cost of a building to house the boilers was saved completely. No special problems arose in the design of boilers for outdoor installation; the lagging is of the normal type, a suitable bitumastic coating being added for waterproofing after the lagging is complete. This coating has been applied to all the lagging and ducting exposed to the atmosphere, and the only parts of the boilers protected by buildings are the front faces, which contain the pulverised fuel burners (eight on each boiler) and the steam drum ends. Small local penthouses enclose the drum ends and provide protection for the water level detection equipment.

Control of the steam temperature over a load range of from 80 to 100 per cent (continuous maximum rating) is by a hollow tube surface condenser which is used to alter the wetness fraction of the saturated steam entering the superheater. Control of the induced draught fan is by hydraulic coupling, while the forced draught fan is controlled by movable vanes in the fan itself.

Ash and dust are removed from the boilers by means of suction equipment built by John Thompson Industrial Constructions Limited. There is no water sluicing, the ash and dust being removed entirely by the suction plants, which deal with the dust from the air heaters and electrostatic precipitators as well. The dust plant is housed in the boiler basement, and discharges to large external hoppers, from which the dust is removed by lorry for disposal.

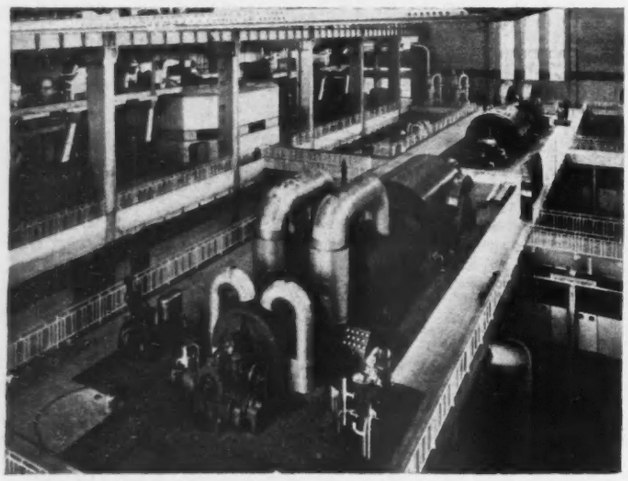
Both generating units, each comprising a boiler, alternator and auxiliaries, are controlled from a central operating room. Here, the instruments and controls are grouped on a large panel which is divided into two identical sections, one for each unit. The instrumentation and automatic control equipment were provided by Evershed and Vignoles Limited, and the system of automatic control, based on electronics, is the first of its kind to be installed by the CEGB. The operating room gives complete remote control over the two boilers and generators comprising units 5 and 6 in the power station (they are numbered consecutively with the four older sets in the "A" station).

Steam pressure and temperature, water and steam flow are the main quantities to be measured for control purposes. Each of these quantities is measured and converted into a proportional electric current by a transducer/transmitter located at the sampling point. The signals are transmitted by telephone type cable to the plant operating room, which is thus free from water, steam and other fluids, and there are no pipelines between the points of measurement and recording. Only telephone cable is used, and a simple layout results.

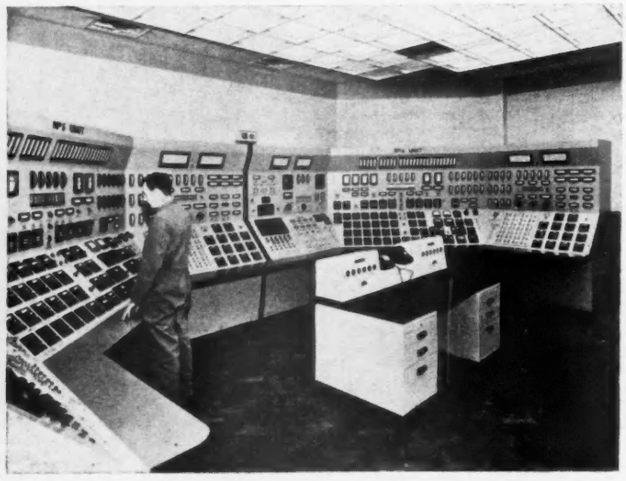
In a number of cases the signals from several transmitters are applied to a beam-balance type computer, the output from which follows predetermined laws. An example of this is the computer for controlling the induced draught fan coupling. This computer receives a signal proportional to the total fuel input to the ball mill pulverisers, together with a signal proportional to boiler combustion chamber pressure. From these two signals the required correction to the fan coupling is made automatically. Conversion from the electric current output to the required plant operating force is by applying the current to the magnet of an oil-jet hydraulic actuator.

The components in the Evershed control system are inherently self-compensating for any variations in supply frequency or voltage, and the length of telephone cable for transmitter signals and computer outputs has no effect on performance. A comprehensive alarm system is built into the control equipment, with audible warning and visual indication of the cause.

Each turbo-generator has its own cooling tower, and is operated on the closed circuit system, which has permitted the elimination of valves in the main circulating water lines. In order to obtain optimum efficiency pumping output is dictated by the value of the vacuum in the condenser. This control is continuously and automatically carried out by the Evershed electronic system.



In this view across the turbine room the coal feeders and boiler faces can be seen in the background.



Complete control of both generating sets and boilers is from a central operations room.

Nerve Centre for Fire Control

A new fire warning system installed by Hoover Limited is claimed to make their factory one of the safest in the world in the matter of fire risks.

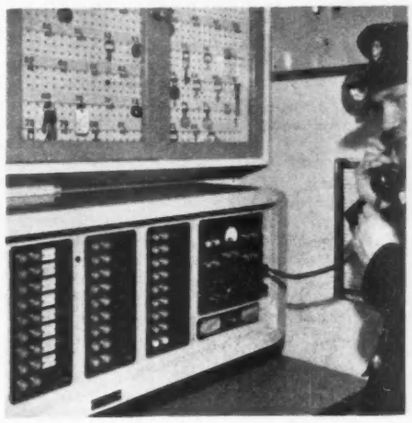
Designed and installed by Sound Diffusion (Auto-thermatic) Limited, Portslade, Sussex, the equipment has 2,000 automatic detectors covering the entire factory, the estimated area protected being 215,000 sq. ft.

Heat-sensitive detectors are installed in every department, room and corridor of the factory, distributed in 26 sections, and their signals are given by duplicated warning lights at a central fire control point. In addition, there are 50 manual alarms of the break-glass type situated at exits.

If an outbreak of fire occurs, the appropriate red lights are illuminated at the control point showing in which section the fire has started, and a siren is sounded automatically.

When the works fire brigade arrives at the outbreak, a report on the situation is sent to the central control room either by a plug-in hand telephone from one of the identical plug points in the factory, or by means of the "dial 6" procedure on the ordinary inter-departmental telephone system. If outside assistance is required, a pre-recorded verbal message is sent from the control room to the Middlesex Fire Brigade.

Sound Diffusion (Auto-thermatic) Limited, operate a scheme for complete fire-detection systems to be installed on a rental basis, as well as by purchase. If the system is rented, it is installed without charge and checked at regular intervals, also on a free basis. An advantage of renting such equipment, apart from the fact that no capital outlay is required, is that the rental can be charged immediately against profits for taxation purposes.



Immediate warning of fire is given by light signal from any one of 2,000 detector points.

Radio Helps the Shunters

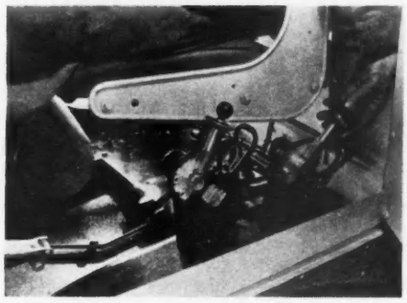
Radio telephony, the first to be used in a marshalling yard of the London Midland Region of British Railways, is now in service at Toton Yard, near Nottingham. Supplied by Murphy Radio Limited, the VHF equipment operates at 169·7 Mc/s, and is used to supplement conventional fixed and hand signalling methods on the up siding. There is two-way communication by loudspeaker between the hump room, control tower and the two diesel locomotives engaged on shunting trains over the hump. Instructions being passed over the system will be heard at all locations, and the engines are equipped with telephone handsets so that the driver can report back and make any necessary inquiries. Control of the system is from the hump room, but the control room can interpose messages if required.

The radio equipment used on the engines is readily interchangeable, two sets being provided for daily use, with a third set in reserve. There are 15 diesel engines in the Toton complement, and as any one of them might be used for shunting on the up siding, provision is made for any engine to be fitted with a radio.

At present, only the up siding is equipped with radio telephony, but when the equipment has been tried out and experience gained in its use, consideration will be given to its extension to the down siding, using a different wavelength.

Starring Road Sweepers

Mechanical road sweepers do much of their work, in big cities at least, during the night, when the traffic is lightest, and the public sees little of them. Night shots of these vehicles at work figure prominently in a 16 mm film of 15 minutes duration, made for Lewin Road Sweepers Limited, Victoria Works, West Bromwich, Staffordshire.



Ease of control is one of the points stressed by a film of Lewin roadsweepers in action.

Various types of sweeper are featured in the film, including the earlier sprinkler-sweeper-collector machine, the "Mechanical Orderly" sweeper, the heavy duty "Sweepmaster" long range vehicle, and the tractor-drawn airfield sweeper. With the Sweepmaster a maximum width of 7 ft is covered, and the machine is equipped with a wire-bristled rotating scarifying brush which is particularly effective for weeding channels and cutting back grass verges on country roads. This brush can be used for back-gritting

The tractor-drawn sweeper covers a strip of ground 7 ft 6 in wide, and with three machines in "V" formation a 20 ft sweep is possible. Specially suitable for airfield sweeping, these machines are similar in principle to the others in the range, sweeping and collection being simultaneous. Water sprinklers are fitted for use when the ground is dusty.

Particular attention is given in the film to the operating features of the machines, the design of all of them being centred on simplicity of handling, so that the driver can concentrate on the job of looking where he is going.

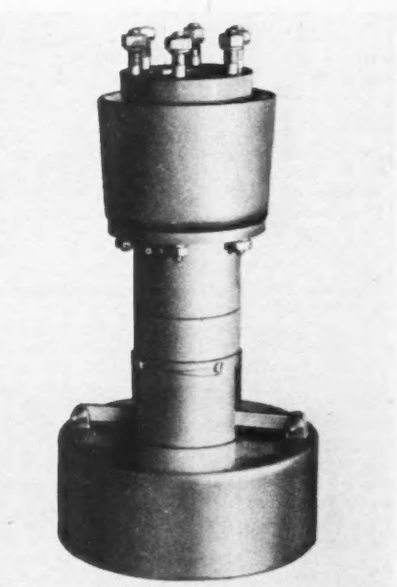
Diesel Fuelling Without Spillage

Feeding fuel into a diesel locomotive tank by the normal method is often wasteful, as it is necessary for the operator to watch several gauges to prevent overfilling. In addition to wasting fuel if there is a spillage, the fire risk is increased. To prevent overfilling and at the same time to allow the job to be done quickly, Zwicky Limited, Slough, Buckinghamshire, have designed, in conjunction with Western Region, British Railways, a bulk loading valve which cuts off the flow automatically when the tank is full.

The valve is mounted on a flange at the top of a vertical pipe within the fuel tank, and has a float which allows fuel to rise to within 1 in of the tank top before cutting off the supply. The lower end of the vertical pipe passes through the bottom of the tank and is connected to a fuelling gallery, which is common to all the tanks, and has a self-sealing coupling.

In the body of the valve are a main shut-off valve and a pilot valve. A diaphragm, also in the main body, opens the main valve, which is closed by a spring. When the fuel coupling is connected, the pilot valve bleeds enough fuel to the diaphragm to allow it to open the main valve, but when the tank is nearly full the pilot valve is actuated by the float, cutting off the supply to the diaphragm.

When used at a pump stalling pressure of 24 lb per sq. in, a single valve passes 64 gallons per minute, two valves pass 40 g.p.m. each, and four valves pass 22 g.p.m. each.



A small Zwicky valve (just over 10 in overall) in the fuel tank prevents overspilling when fuelling.

On the Shelf

By Frank H. Smith

I notice that the Civils are now about to do what the Architects have done for a long time —display a standardised signboard on works in course of construction for the design of which they are responsible. Any moment now the medical men will have a similar board for putting outside the houses of those whom they are attending, and prams will bear a legend " Delivered by Dr. Soandso." In the same number of the *Proceedings* is a letter—a follow-up by the same author of one a year ago—in which is advocated our old friend the central building to house the engineering professions' bodies. An excellent idea indeed but somewhat spoiled by the writer's parochial (but quite usual) attitude restricted to the Big Three. It really is time that Winking, Blinking and Nod woke up to the fact that there are as good fish in the sea as ever came out of it.

UNESCO have produced *Statistics of Newspapers and other Periodicals* at 5*s* from HMSO. If figures can be made to prove everything (and as far as I am concerned they can because I just go into a hypnotic acceptance trance) here is material by the bucketful. Imagine those women in UNESCO who compile " Number and circulation of general interest newspapers (daily and non-daily) by language of publication " (Table 4). To say nothing of the 25 footnotes thereto. Or Table 7 on " Circulation of periodicals other than general interest newspapers by frequency of publication (in thousands)."

For the periodicals of Korea, they have contrived to whip up 305 periodicals with five categories of periodicity and in eleven subject groups. Pygmalion marvellous. And how's this for a footnote (to USSR's 2,787 periodicals with 435,406,000 circulation): "including 286 'specialised newspapers' with an aggregate circulation of 15,171,000 copies intended for certain categories of readers (children and juveniles, peasants) or specialised in certain fields (agriculture, technology, transportation, culture and education, sports, etc.)." I do hope you get the general picture.

Isn't it delightful how some titles trip off the tongue. Take this new Pergamon *Axiomatics of Classical Statistical Mechanics*. You can almost sing it or at any rate chant it if it is properly pointed.

Griffin (42 Drury Lane, London, WC2) seem to have a passion for books on statistics. They have a special leaflet on their " Statistical Monographs and Courses " edited by the Prof. of Stats. at Univ. of London.

Collett's (Museum Street, London, WC1) have sent me their usual list of Russian titles (and by Russian I include other trans-curtain countries) and tucked in it was a booklet, " Educational, Cultural and Specialised Tours to the Soviet Union," issued by Wayfarers Travel Agency of 44 Torrington Place and 20 Russell Square, each in the WC1 district of London. An education tour of Moscow and Leningrad for 14 days costs £129, architecture and town planning (Moscow, Leningrad and Kiev) 14 days, £149, and so on. For 22 days on a historical tour of Moscow, Zagorsk, Leningrad, Tashkent, Samarkand, Tbilisi, Sukhumi, Yalta and Simferapol you have to fork out £273 7*s*, but what's the good? You wouldn't be able to boast to your friends about it because you would not be able to pronounce the names. But that juxtaposition of Samarkand and Yalta does appeal to me all the same.

> The lucent syrops, tinct with cinnamon;
> Manna and dates, in argosy transferr'd
> From Fez ; and spiced dainties, every one,
> From silken Samarkand and to cedar'd Lebanon.

Follow that quotation with a slide of the Big Three at Yalta and no lecture could fail to appeal in the church hall. Soon get your £273 back.

What to Look for in a Textbook

Mathematics for Higher National Certificate. By S. W. BELL and H. MATLEY. Volume 1. 2nd Edition. *Cambridge University Press.* (16*s*)

The author of a book designed for students taking the mathematical parts of the Higher National Certificate must face as his chief obstacle the fact that it is unlikely that his readers will be devoting their full time to their studies. In consequence, in the exposition of those topics chosen by the author, unimportant detail must be vigorously weeded out, and care must be taken to see that there are plenty of worked examples in the text, each with a clear indication of the techniques involved. If these two rules are followed, and if in addition there is given a good collection of examples, with answers readily available, then the part-time student will not feel overwhelmed with the job of sorting through large numbers of new ideas every time he turns to a new part of the syllabus, and, by following the worked examples, he should be able to start practising the techniques which he must learn to use.

The authors of the present textbook have clearly had these ideas in mind, at least in their Volume 1 under review, which deals with the A1 mathematical course of the HNC. They give at each stage a brief revision of the relevant parts of the Ordinary National Certificate, and then take the student through the subsequent theory of the A1 course, doing examples as necessary. At times the teacher may feel that the revision is perhaps too brief, or that it assumes too great a knowledge. For example, one might perhaps justifiably wonder how many students with an ONC will really be as familiar as the authors assume with the techniques of first and second moments. Again, in the attempt to cover the majority of the syllabuses for the A1 courses taught up and down the country, there will inevitably be those in the minority who will find part of their course missing.

But with these matters on one side, the book should form a useful guide to both students and teachers. For the latter it will afford a source of examples and a suitable basis for lectures, for the former it should prove a helpful addition to the usual teaching in the part-time course which he will no doubt be attending.

In this second edition the opportunity has been taken to correct some errors and misprints of the first edition, although in the first section of chapter 6 the authors still refer the reader at first to chapter 3 (which is on hyperbolic functions) for revision examples of integration, and then correctly, to chapter 2.

W. H. COCKCROFT

University Mathematics. By JOSEPH BLAKEY. 2nd Edition. *Blackie and Son.* (35*s*)

Dr. Blakey's book, *University Mathematics*, is a book on pure mathematics intended for students of science and engineering in their first year at a university. In the second edition two chapters on spherical trigonometry and moments of inertia have been added, and the book now covers the whole of the part 1 and some of the part 2 syllabus for the London general degree. The book was originally written as a textbook for the London general degree examination in pure mathematics, under what are now known as the " old regulations." It is a useful book for students taking this examination as it contains a large number of examples, both worked and unworked, reprinted from recent examination papers.

Unfortunately, apart from this, there is little in the book to recommend it. The chapters on geometry and trigonometry are competent but not inspiring and, in particular, the treatment of the general conic is disjointed. However, it is in the chapters which involve analysis that the main weakness is to be found. In my opinion, these chapters contain a lot of bad mathematics which is not excused by the author's statement that the analysis is not intended to be rigorous. For example, the proof of the theorem on the convergence of alternating series is completely wrong and I do not see any value in a proof of the theorem on the interchange of order in partial differentiation which assumes, as obvious, the essential point of the proof.

Many other examples of wrong and careless statements could be quoted and I cannot recommend the book, as a textbook on mathematics, to any class of student.

F. BRICKELL

Mathematics Applied to Electrical Engineering. By A. G. WARREN. *Chapman and Hall.* (70*s*)

It is now, rather surprisingly, twenty years since the first edition of this work originally appeared and during this time it must have given immeasurable help and encouragement to thousands of practising engineers.

Indeed, this was the intention of the book as originally planned, for many of the mathematical studies treated by Mr. Warren did not receive attention in the general run of university degrees until comparatively recently. Thus, the first edition has always been regarded by electrical engineers as a classic—a book to which one referred first whenever an unfamiliar problem was encountered and which could almost invariably be relied upon to help one on the way.

Although university engineering degree courses today " cover " more mathematical topics of an exotic nature than formerly, the new second edition will undoubtedly sustain the author's reputation and must still find its place in the personal library of most electrical engineers. The text is written with enthusiasm and the great merit of the book lies in the wealth of electrical applications discussed.

The mathematical topics covered are differentiation and integration, differential and partial differential equations, Bessel functions, Fourier analysis, functions of a complex variable, the operational calculus and conjugate functions. The main changes from the first edition are a new chapter on functions of a complex variable and chapters on operational calculus and Fourier analysis which have been completely rewritten. The operational calculus is now firmly based on the Laplace transform and the chapter on Fourier analysis includes a section on Fourier integrals. Unfortunately the very helpful section on numerical harmonic analysis has disappeared. New electrical topics discussed are frequency modulation, non-destructive testing of conducting materials, analogue computers and other analogue methods including, for example, the thermal flow simulator.

An important gap in the mathematics is the lack of a section on infinite series. In view of the extent to which infinite series are used in the text a precise definition of their convergence and some discussion of their properties would have made the book more self-contained. In some places the presentation of the mathematics could have been improved. For example, the definition of a total differential is obscure and Mr. Warren does not always distinguish between a proof and a " plausibility " argument. On the other hand the foundations of the theory of functions of a complex variable are laid precisely.

It is, however, in chapter 5 dealing with fundamental electrostatics and electromagnetism that Mr. Warren must be prepared to raise the greatest controversy. Although it is claimed that " the preparation of the second edition has provided an opportunity of a thorough revision of the text," the majority of this chapter remains written in mixed c.g.s. units—instead of the more generally accepted MKS system. This is evidently deliberate, as the author clearly does not like the MKS system, on the grounds that the basic facts of electricity and magnetism do not then fall into a " significant and satisfying

scientific pattern." It may be argued that it should not matter to a mathematician what units he works in so long as he represents physical principles correctly, but it is unfortunately a fact that several misconceptions are traditionally associated with the c.g.s. system, and these Mr. Warren faithfully reproduces. Thus, for example, the force on a current-carrying conductor in a magnetic field is given as $H\,l\,I$ and that on a moving charge as $H\,q\,u$. Yet, at the end of this chapter in six pages devoted to a comparison between the MKS and c.g.s. systems, the same formulae are given as $B\,l\,I$ and $B\,q\,v$. The author is haunted by the "4π problem" to such an extent that a subsection is so headed. Surely it is an archaism to retain, as Mr. Warren does, Maxwell's original use of a rationalised system so far as electric fields are concerned but an unrationalised system for magnetic fields. Neither does it help to be told that, for soft iron, μ is about 0·00188; Mr. Warren does not seem to have heard of the generally accepted term relative permeability.

On what one may call the philosophy of the subject Mr. Warren is also weak. Few engineers would agree that mass is defined by reference to its inertial abstract.

In revising the text, the author has made but one concession to the recommendations of BS 1991 on symbols—namely, the use of ln to represent a natural logarithm—and he is occasionally rather careless in his notation. For example, on one occasion the symbol f is used both for a function and for frequency in the same equation, while elsewhere, unnecessary ambiguity is caused by the use of the lower case epsilon (ϵ) for the natural logarithm base *and* for permittivity of a dielectric. In appendix III the lower case kappa (κ) is used for this quantity.

Despite these criticisms the overall impression is of a sound reference book which can be thoroughly recommended to all electrical engineers.

F. Brickell and R. Yorke

Higher Electrical Engineering. By J. Shepherd, A. H. Morton and L. F. Spence. *Pitman.* (40*s*)

For students to possess their own textbooks to supplement lectures is of immense value and for the A1 and A2 courses of Higher National Certificate, one drawback for the student has been the fact that several books were required for complete coverage. The publication of this book, which sets out to cover the whole course is therefore very welcome. The book is intended to cover the electrical engineering content of the A1 and A2 years and assumes the prior attainment of Ordinary National Certificate level.

The author's attempt to encompass such a large amount of material in one volume of reasonable size and price, has, considering the difficulty of the task, been largely successful. The only serious omissions in subject matter are the absence of a more advanced treatment of measuring instruments and further work on illumination.

The book (in which the rationalised MKS system is used throughout) may be divided into three main sections—fundamentals (chiefly such topics as circuit theory, harmonics, transients), power and machines, and electronics.

In the fundamentals section the coverage of subject matter is comprehensive and the treatment mainly clear and concise. Of special merit is the use of the "dot" notation for coils when considuring mutual inductance which clarifies a sometimes vaguely presented topic. Also in this section, the work on field plotting and the consequent estimation of resistance, inductance and capacitance of configurations frequently found in practice is very welcome.

In the chapters on transformers and synchronous machines the convention that the e.m.f. induced in a coil due to a changing flux is $+N\frac{d}{dt}$ is used, and according to the authors, this facilitates the understanding of these topics. The effect of this convention on the vector diagrams for these machines is profound and the mere statement that this convention is to be used without any explanation or discussion will doubtless cause much confusion to students who are conversant with the traditional treatment.

The chapters dealing with the operation of large power systems follow the conventional methods of approach and include a brief but effective treatment of circuit breakers. It is unfortunate that the very important subject of protective gear is not even mentioned and this spoils an otherwise comprehensive treatment of power systems at this level of study. The section devoted to electronics covers vacuum valves, amplifiers, feedback, oscillators and gas-filled valves and the treatment is clear and concise, much use being made of the constant current equivalent circuit. This section is complete and compact and provides a solid foundation of knowledge on which to build the more specialised and advanced aspects of the subject.

A notable feature throughout the book is the way in which the subject matter is consolidated by a large number of worked examples, and each chapter is supplied with questions for student exercises. The authors have produced a book designed to meet the usual requirements of the Higher National Certificate examinations and with the exceptions noted above, have been successful. Students preparing for these or similar examinations should find it very useful indeed.

B. M. Weedy.

Break-Even Contour Lines

The Economics of Nuclear Power. Volume 2. Progress in Nuclear Energy, Series VIII. By I. R. Maxwell, P. W. Mummery and Philip Sporn. *Pergamon Press.* (105*s*)

People have recently been taking a second look at the promises made for nuclear power, and it is refreshing to be reminded of the world-wide interest in its development. Whether in countries with ample resources of fuel or none at all; with cheap fuel or dear; whether industrialised and rich, or underdeveloped and poor; each—with varying degrees of immediate incentive or far-sighted wisdom—seem to have made some start on the exploration of nuclear power. A survey of the main national programmes is given in a new book in the Progress of Nuclear Energy series, including sections on the expected growth of demand for nuclear power and the corresponding logistics of fuel supply.

The treatment is as even as could be expected from the way in which these volumes have been prepared. Twenty-five papers, five of them by British authors, have been selected from about ten times as many which were presented in 1958 to the economic sessions of the Geneva Conference. Readers professionally concerned with these aspects of nuclear power will find it useful to have this collection available, including as it does many of the papers which were presented orally on this subject, together with half a dozen others. The book is adequately indexed and will prove a useful source of reference to the serious student, most of the papers having their own bibliography. The subject is still in its very early days, however, and, although the theoretical treatment will remain valid, some of the information and arguments based on detailed costs may become rather quickly out of date.

Most of the emphasis is still placed on the generation of electricity from large central stations. The application of nuclear energy to other purposes—process heat, irradiation sources, marine propulsion or small generating units—has its supporters in many countries. But there are serious problems in each case, including the familiar penalties of working on a small scale.

The outlook for electrical generation is better, and it is much to the good that more realistic forecasts are now being made. The full cost of a nuclear station is now seen to include charges for site preparation, for engineering and for development, together with an allowance for interest during construction (in cases where this is a practice of the board or company concerned). There is a better appreciation of the cost of manufacturing to exacting specifications, and of the difficulties of making a bold step forward to new methods or materials, or to more exacting working conditions.

For these reasons a more sober estimate may now be made of the part which nuclear power will play in the next 10 or 15 years. It remains clear that the role of nuclear power will be of considerable economic significance. Long-term forecasts in many countries show a doubling of electricity consumption every ten years or so, particularly where the rise in population or in standard of living is expected to continue as vigorously as at present. With nuclear power getting cheaper, and with conventional power nearing the point at which further rises in thermal efficiency will be hard to obtain, it is only a matter of time before nuclear power takes over an important part of the generating field.

This book is concerned with the prospects of nuclear power from fission, the outlook for thermonuclear power being still so far off that no economic treatment can yet be essayed. Abundant reserves of uranium have now been found, and current methods of mining and recovery in the main production areas are authoritatively described. Provided there is no further major expansion of military production, there will be no shortage of uranium (at prices less than or equal to those now prevailing) for several decades to come, even with the most optimistic assumption about the growth of civil power programmes. It seems to be tacitly assumed that enriched uranium could be provided at a reasonable cost (even if not quite as cheaply throughout the world as the American diffusion plants could offer), and that the cost of building new diffusion plants would not necessarily have a significant effect on the pattern of nuclear power programmes.

Supplies of enrichment from diffusion plants will be augmented with increasing quantities of plutonium, and three ways for the use of this material are described. The best of these, assuming that reasonably cheap reactor construction and fuel processing can be achieved, would be with the fast breeder reactor. America, Russia and this country have all expressed considerable hopes for this method. A more obvious way of burning plutonium would be as a replacement for separated uranium 235 in enriched thermal reactors. This would probably mean a lower value of plutonium, however, certainly less than that of the separated uranium 235 which the plutonium would be replacing; neither the cost nor the time-scale of solving the problems of plutonium fuel have yet been fully weighed, whether in terms of the nuclear properties of the higher plutonium isotopes and their influence on problems of fuel effectiveness and control, or of the problems of the alpha-active manufacture of reliable fuel elements. A third way, suggested by Canada, was to burn the plutonium without extraction in long irradiated natural uranium fuel elements. This would seem to imply an even lower value of plutonium, however, equal to that of the fissile content of the natural uranium which it replaced.

The problem of a surplus of plutonium still

Continued on next page

seems several decades away. Certainly before that time it might be hoped to start exploiting thorium—an alternative fuel attractive to a number of countries not possessing uranium reserves, but which requires a substantial additional investment of fissile material for its consumption. The conclusion to be drawn on the question of the logistics of fuel supply, therefore, seems to be that the basic materials are assured, but that the methods of obtaining the necessary additional fissile material still remain an open question.

Nuclear power is well known for its low fuel costs, an important factor for countries without indigenous fuel which seek to limit the ever-growing drain on their foreign currency reserves. It seems certain that the cost of nuclear fuel will fall, whether from improved usage or from the expected fall in price of natural uranium (painful to the newly established mining communities though that may be). For the latter reason alone, nuclear power in Britain is expected to become some 10 per cent cheaper in due course. Conventional fuel, on the other hand, has, until the appearance of the recent surpluses, been getting steadily dearer, and it is unlikely to do better than remain at present price levels. The new volume makes clear that a great effort is being applied to cheapen nuclear power in years to come, particularly by raising temperatures and heat ratings in order to bring down the all-important capital and inventory charges. Each year, from the second half of the 1960's onwards, will see nuclear power breaking even with conventional power in some new area in the world; first in high fuel-cost regions and for base-load demands, and then spreading to more exacting areas and conditions until in 30 or 40 years' time we shall see nuclear power as one of the most commonplace features of our surroundings.

J. L. GILLAMS

Meeting Point of Mathematics

Ordinary Differential Equations. By WILFRED KAPLAN. *Addison-Wesley Publishing Company, Reading, Massachusetts; and London.* (68*s*)

The theory of differential equations may be regarded as occupying a central position in the distribution of the sciences, and from this centre radiate many paths. The purely analytical path leads to infinite series, existence theorems and the theory of functions. The differential geometry of curves and surfaces and topological methods offer alternative routes. Turning from the general direction of pure mathematics, one is directed to the study of mechanical and electrical vibrations. In yet another direction lie such technical questions as concern servo-mechanisms, automatic controls, computers and electronics.

The problem before an author when writing a book on differential equations is how to give a complete account of the subject without appearing disjointed. Many have attempted to avoid the problem by limiting the development to one direction. Thus books on the subject have been written for pure mathematicians, for physicists, and for engineers of various kinds. Few have attempted to solve the problem. In November, 1958, a new book entitled *Ordinary Differential Equations*, by Wilfred Kaplan, was published. Within the limitations imposed on the subject by the word "ordinary", Professor Kaplan has succeeded in producing a book which gives to the subject its true breadth. This he has done, not by over emphasising the applications of the subject but by brief excursions, either in the text or through the problems set at the end of each chapter, into various branches of physics and engineering which, coupled with "suggested references" at the end of each chapter, fulfills the condition of sufficiency.

The only previous knowledge assumed embraces the elements of the differential and integral calculus, a little coordinate geometry and some elementary algebra. In the main the text is straightforward to read and the examples easy to solve. The proofs of principal theorems, being rightly regarded as rather difficult, are placed in the final chapter, while the more difficult examples contain sufficient hints to enable the student to solve them.

The book is mainly concerned with the linear differential equation. The importance of graphical and numerical solutions is immediately established before moving on to the solution in explicit form of the first-order linear equation. Generalisation of the order leads naturally to a discussion of the Laplace transform. In all cases, including that of the simultaneous linear differential equation, the stability of the solution is discussed through an "input-output" analysis. Always aware of the applications of the subject, the author is quick to point out that the laws of growth of populations is of an unstable character which, to quote the author, "is perhaps the reason why life on this planet is so difficult to manage"! One is constantly reminded that "experience has shown that, except for a few special types of equations, the problems are difficult" so that it comes as no surprise to find the solutions in terms of power series followed by an introduction to numerical methods.

The book is recommended as a textbook to the undergraduate whether he be of the pure or applied school, physicist or engineer, to the graduate as a reference book and to the lecturer as an up-to-date outlook on a familiar subject.

H. J. DAVIES.

Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Electronics

Wideband Transmitter. MARCONI'S WIRELESS TELEGRAPH CO. LTD., Chelmsford, Essex. Wideband transmitter of 1 kW HF output; 2 to 24 Mc/s. Descriptive booklet.

Thermal Relays. COVENTRY CONTROLS LTD., Godiva House, Allesley Old Road, Coventry. Thermal relays for all purposes: overload, timing, etc. Data sheets.

Photoelectric Controls. RADIOVISOR PARENT LTD., Stanhope Works, High Path, London, SW19. Photoelectric and electronic controls for counting, smoke alarm, level control, etc. Folder.

RF Cables. TELEGRAPH CONTSRUCTION AND MAINTENANCE CO. LTD., Mercury House, Theobalds Road, London, WC1. Helical membrane radio frequency cables with polythene or ptfe spacing helix for up to 12 kV peak voltage. Particulars and characteristics given in publication No. ME/7.

Microphone Insets. AMPLIVOX LTD., Beresford Avenue, Wembley, Middlesex. Miniature electromagnetic microphone insets for general use. Frequency range from 200 to 7,000 c/s. Leaflet gives details.

Torque Motors. DE HAVILLAND PROPELLERS LTD., Manor Road, Hatfield, Herts. Electromechanical torque motors up to 2,500 gm-cm. Range of 12 types. Details in publication 5078.

Digital Recorder. SOLARTRON ELECTRONIC GROUP LTD., 45 Thames Street, Kingston, Surrey. Digital data recorder, multichannel operation, accuracy to within 0·1 per cent. Leaflet.

New Books

Mechanisation of Thought Processes: Proceedings of a Symposium held at the National Physical Laboratory, November, 1958. 2 Volumes. *Her Majesty's Stationery Office.* (50*s*)

A total of 32 papers was presented at the symposium (reported in the article "Mind in a Black Box," ENGNG., vol. 186, 1958, p. 728), and it is valuable to have them in permanent form. Papers of particular interest include those on the mechanisation of administration and automatic control by visual signals.

Reinforced Concrete Simply Explained. By OSCAR FABER. 5th edition. *Oxford University Press.* (12*s* 6*d*)

Written first in 1922 as a simple book for the non-specialist, this fifth and posthumous edition has been revised by Oscar Faber's son to take account of the latest revision of CP114.

An Introduction to Plasticity. By WILLIAM PRAGER. *Addison-Wesley Publishing Company, Reading, Massachusetts, and London.* (49*s*)

Intended to supplement texts on materials and structures which are primarily concerned with elastic behaviour. Much of the material in Professor Prager's book is of sufficiently recent origin not to be found in the standard works.

Liquids and Liquid Mixtures. By J. S. ROWLINSON. *Butterworths Scientific Publications.* (75*s*)

Dr. Rowlinson has attempted to bring together two subjects which have tended to be studied in isolation. The book has been used as the basis of advanced courses for graduates in industry.

Directory of Railway Officials and Year Book, 1959-1960. *Tothill Press.* (60*s*)

New refinements to this invaluable "who's who" of world railways are a classified index of suppliers of signalling and interlocking equipment, and thumb index tabs. The publishers have taken advantage of printing delays by including revisions up to the end of September last.

Fifth International Conference on Hot Dip Galvanizing, 1958. *Zinc Development Association, 34 Berkeley Square, London, W1.* (63*s*)

The proceedings of the fifth conference held by the European General Galvanizers Association are made up of 20 papers. These have been divided into subject chapters, which with the addition of an annotated contents list and edited discussion makes this more easily used than is usual with conference reports.

The Reviewers

Dr. W. H. Cockcroft, M.A., and Dr. F. Brickell, B.Sc., are in the department of mathematics at the University of Southampton; Mr. R. Yorke, B.Eng., B.Sc., and Mr. B. M. Weedy, B.Sc. (Eng.), A.M.I.E.E., are in the department of electrical engineering at the same university.

Mr. J. L. Gillams, M.A., is on the senior staff in the London office of the United Kingdom Atomic Energy Authority. He was previously assistant director, Technical Policy Branch, UKAEA, and has also served as experimental officer in the Admiralty Radar Establishment.

Dr. H. J. Davies is lecturer in applied mathematics at the University of Southampton, but was recently seconded as research associate to the James Forrestal Research Center, Princeton, New Jersey, USA. He is a graduate of the Welsh University, pursued his post-graduate work at the Imperial College of Science and is an A.F.R.Ae.S.

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This is typical of the numerous examples to be seen on the B.S.F.A. Stand No. 48 at the Engineering Materials and Design Exhibition, Earls Court, 22nd to 26th February.

BSFA STEEL CASTINGS

THE BRITISH STEEL FOUNDERS ASSOCIATION

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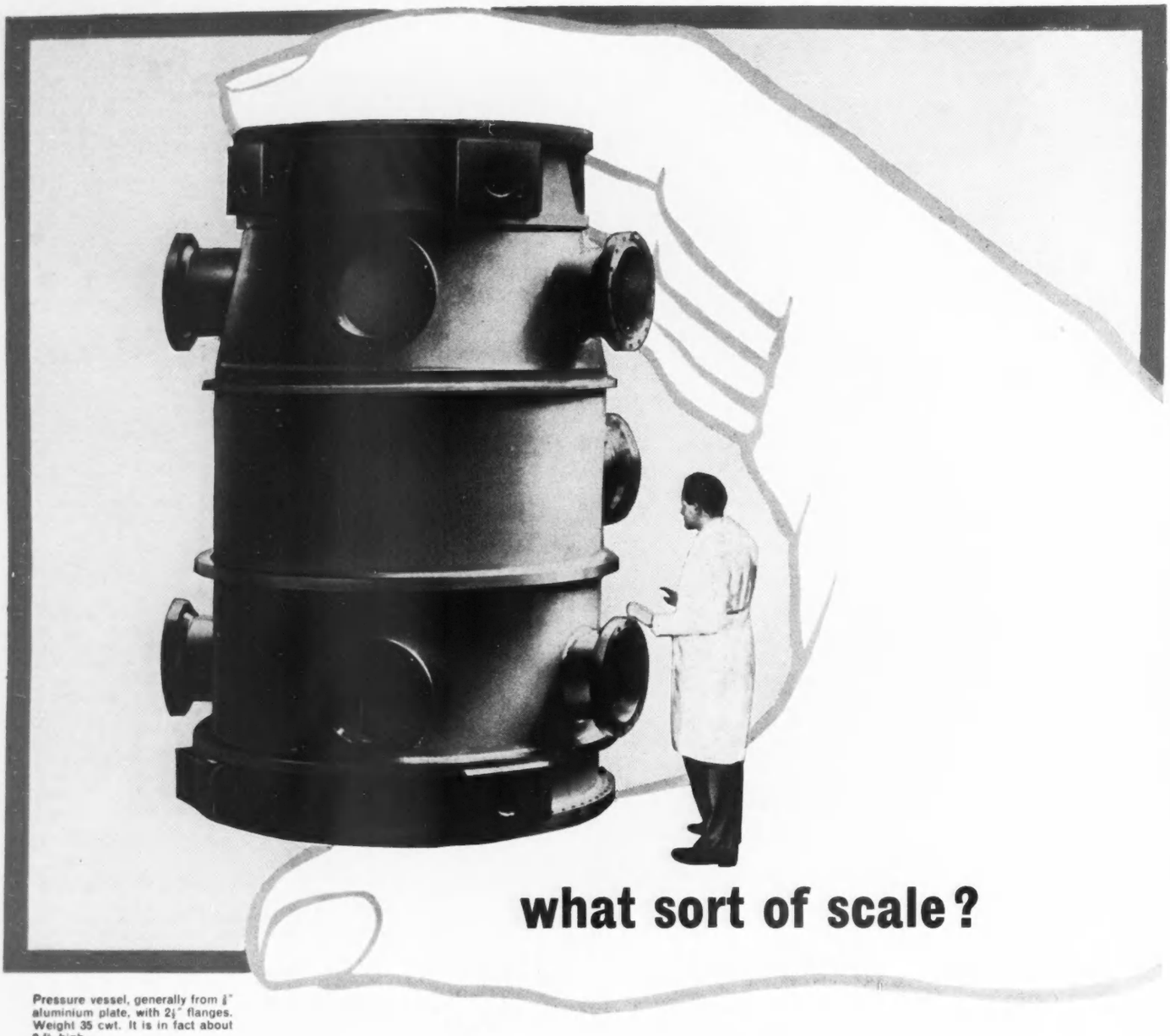

what sort of scale?

Pressure vessel, generally from ⅜" aluminium plate, with 2½" flanges. Weight 35 cwt. It is in fact about 9 ft. high.

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Marketing

First Pacific Telephone Cable

The planned trans-Pacific cable, from Vancouver to New Zealand and Australia, has now been approved by the four governments concerned. They are Britain, Canada, Australia and New Zealand.

The £26,300,000 million line will be the second stage of the round-the-world telephone cable system, proposed in 1958 at the Commonwealth Telecommunications Conference of which CANTAT, the new cable link to Canada, is the first. CANTAT is due to be finished next year.

The Pacific cable (PACTAT?) is likely to be completed by 1964. Some of its 8,000 nautical miles of cable and 300 under-sea amplifiers will be at a depth of almost four miles.

CABLE AND WIRELESS Limited are to act for the United Kingdom Government in the construction, financing and maintenance of the cable. The British share of the cost is £8,300,000. A four member management committee, made up of one representative of each country, will control the joint development group. The group is to be led by Mr. D. J. Halsey, director of research at the Post Office, a leading figure in the development of long submarine telephone cables.

The British designed line will use lightweight cable and rigid repeaters pioneered in this country and being used in CANTAT. Eighty simultaneous conversations will be possible on the Pacific cable and any one telephone circuit may be used for 24 telegraph channels.

Coal at a ½d a ton

The lively arguments in British Columbia, Canada, over the international development of the Columbia river may be displaced by a rival to hydro-electric power in the form of 340 million tons of coal.

The BRITISH COLUMBIA ELECTRIC Company has paid $2 million (about £750,000) for all this coal, which is known as the Hat Creek deposit, about 180 miles from Vancouver. The deposit is concentrated within a square mile and it is believed there are further reserves of about the same amount.

The 2,600,000 h.p. generating station which the company is understood to be planning is close to its own Bridge river hydro-electric scheme that supplies power to the Vancouver district.

Machine Tool Licence Agreement

The ALBERT MANN Engineering Company of Basildon, Essex, has reached a licensing agreement which carries the rights to make the metal processing equipment of an American company for the Commonwealth, apart from Canada, and the Seven states of the British led European Free Trade Association.

The United States firm is LOMA MACHINE MANUFACTURING Incorporated, with its subsidiary, LOBECK CASTING PROCESSES, of New York City.

At the same time Albert Mann have taken over the share capital of ROLL RACE CONVEYORS Limited and with it the right to make and sell conveyors and handling equipment which incorporate the Roll Race system of rolling loads.

Taking the two agreements together Albert Mann are now in a strengthened position in providing for the Commonwealth and the European metal industries a range of designs including rolling mills and related equipment, roller levellers, continuous non-ferrous strip casting and rolling lines.

Car Sales in Sweden

Among the European nations, Sweden is a significant guide to British car export chances. One Swede in every ten is the owner of a car. Put another way, this means a total of 122,694 new registrations in 1959, an increase of 9 per cent over the year before. Where did all these new cars come from? The biggest single source was Sweden's own manufacturer VOLVO with nearly 28,000. Close behind came VOLKSWAGEN with 23,000, followed by another German, OPEL, with 18,000. Next came the SAAB, another home produced car, which accounted for 7,500, and FORD (Cologne) 6,300. The British makers on the list were BMC and Ford with 6,000 and 5,900 new registrations respectively. VAUXHALL which was in twelfth place had 2,600 and the ROOTES GROUP in seventeenth had 330.

An interesting feature of the performance table of Europe's motor makers in Sweden, is the great success of the Germans and the moderate showing of the French. Taking registrations by countries, Germany sold 57,790 new cars in Sweden in 1959, an increase of 7 per cent. The two Swedish companies totalled 33,377, a rise of 30 per cent. Britain's sales added up to 15,090, a drop of 15 per cent. France had only 8,844, but this represented an increase of 11 per cent over the previous year. Of the individual makes the big gains were made by Volvo, Volkswagen and Saab. All the leading British makes showed a drop in sales. This is disappointing as Sweden is the number four market for British cars, taking about 4 per cent of the industry's annual output.

The tariff on cars entering Sweden will drop to 10 per cent so far as Britain is concerned when the cuts take place on 1 July next; it is now 15 per cent. Is this margin going to be enough to give the industry an edge on the Germans? It might, given a hard selling campaign to put British cars over. Otherwise the chances are that more Swedes will be driving Volvos and Volkswagens again next year.

Machine Tool Order Book

In the midst of all the debate on the machine tool industry orders are steadily picking up. The CROWTHORN ENGINEERING Company, of Reddish, near Stockport, is one firm that now has a full order book and has found its delivery times lengthening over the last three or four months.

Export orders are being dealt with for the United States, India, Australia, South West Africa, Nigeria, Portuguese East Africa, Libya, and Mauritius.

A recent Indian order, from TATA Limited, is for a Crowthorn 18 in heavy duty centre lathe admitting 10 ft 6 in between centres.

Small Car Exports to USA

As the sales chart of British, European and Japanese small cars sold in the United States of America soars to new record heights the car designers of Detroit are stimulated to respond.

The compacts, the FORD Falcon, CHEVROLET Corvair and CHRYSLER Valiant are all said by American trade officials to be selling well. And now Ford have announced that they are discussing putting on the market a car to compete with RENAULT's Dauphine and the VOLKSWAGEN.

Meantime Britain last year again sold more cars in the United States than any other importer. The number of British cars sold there was 210,494 and they were worth about £93 million.

The total of foreign cars imported into the American market, by far the most promising for the world's car firms, was 688,070, valued at £262 million. This is well above twice the value of foreign cars sold in the US two years ago.

West Germany was close behind the British sales figures, France was advancing very rapidly in the list and next was Italy, followed by Sweden.

There is a fair chance as American advertisers sing the praises of their "compacts," and of the virtues and convenience of being a two or three car family, that instead of cutting out ourselves and other exporters they will succeed in markedly enlarging the market. If our advertising is capable and the cars backed by better than average service we ought to be able to keep and improve our place.

Polythene Talks in London

The purchase by East European governments of IMPERIAL CHEMICAL INDUSTRIES' technical knowledge of the production of Polythene is shortly to be discussed in London.

Returning to London from Warsaw, Mr. S. Paul Chambers, the chairman-elect of ICI, said "If the plants to make Polythene are built in these countries they will not be small ones. It is not a matter of thousands of pounds but of the seventh figure."

The countries with whom this more-than-a-million deal with ICI may be arranged are Poland, East Germany, Czechoslovakia and Rumania. Mr. Chambers had been invited to Warsaw by the Polish Government.

Brazil Refinery Equipment Order

Membership of BREFCON, the British consortium formed to supply plant for the PETROLEO BRASILEIRO SA (PETROBRAS) Duque de Caxias refinery, in Rio de Janeiro, Brazil, has led to JOHN THOMPSON (WOLVERHAMPTON) LIMITED obtaining the largest contract of the company's history, apart from those involving boiler making or nuclear power station equipment.

Through the Foster Wheeler Corporation of New York, who with Foster Wheeler Limited of London are the engineering contractors for the Petrobras refinery, the company was awarded a contract to make rotatine disc contactors worth £116,000.

The contactors, made under licence from Shell, are the largest yet designed and are the first to be made in the United Kingdom. Each vessel weighs 85 tons and is 55 ft long and of 9 ft diameter. They are made up of pressure vessels welded to Class I pressure vessel standards and of internal shafts with rotating discs, housings and bearings. Production has already begun.

A gamma source of 1,500 curie and of 2 cm diameter is being used for weld examination. There are less than a dozen of these sources in Britain. This one came from the United States and was fitted into a casting by Newton Victor—the X-ray section of Metropolitan Vickers.

New Model Export Contracts

A new form covering general conditions of export contracts has been issued by the Councils of the Institutions of Mechanical and Electrical Engineers.

The new model form is the work of the joint committee of the two institutions on model forms of general conditions of contract.

The full title of the new form is "B 2" 1960—Export Contracts—Delivery f.o.b., c.i.f. or f.o.r., with Supervision of Erection. It supersedes the old Institution of Electrical Engineers model form B 2 (1928) (Export—including complete erection or supervision of erection).

The complete range of model export forms now available from the secretaries of the two institutions is:

"B 1" (1956) (Export-Delivery f.o.b. or c.i.f.)—*4s 6d.*

"B 2" (1960) (Export Contracts-Delivery f.o.b., c.i.f. or f.o.r., with Supervision of Erection).

"B 3" (1954) (Export contracts—including delivery to and erection on site of mechanical and electrical plant)—*5s.*

The Association of Consulting Engineers' title appears on the title page of each model form. The ACE recommends use of the joint export model forms to its members.

The Busy World of Oil

From Scotland, Russia and Australia come reports of the unceasing installation of pipelines, terminals and special plant.

In the Soviet Union work has now begun on the pipeline which will by the mid-1960's be carrying oil from the Volga to Poland, Czechoslovakia, Hungary and right into East Germany.

The REGENT OIL COMPANY has announced a £500,000 plan for a terminal at Granton Harbour, Edinburgh, where more than 8 million gallons of petrol products will be stored.

The SHELL companies in Australia are to spend £A22 million on new industrial schemes. £A17 million is to be spent on a new catalytic cracking plant for the production of motor fuel. With a capacity of 150 million gallons a year this will be one of the largest "cat-crackers" in the world and will bring the annual output at the Clyde refinery to over 250 million gallons. The total Australian consumption of motor spirit is 1,000 million gallons a year from the latest reports.

Moving Heavy Assemblies in the Shops

A mobile pallet has many applications, such as handling heavy sub-assemblies. This pallet, which is on wheels, is loaded in one crane bay of the shops, and then traversed to another bay where there is a crane big enough to handle the whole assembly.

In heavy engineering, electrical or otherwise, a large unit must usually be assembled in a bay that has a crane big enough to lift the complete product. The mobile pallet described here enables assembled transformer cores and windings to be transferred from an assembly bay served by a light overhead crane into the main shop served by a heavy capacity crane.

It was designed by W. S. Atkins and Partners, consulting engineers, 158 Victoria Street, London, SW1, for Hackbridge and Hewittic Electric Co, Ltd., Walton-on-Thames, and consists of two basic components: the pallet (8), Fig. 2, which supports the product during assembly, and is cast in reinforced concrete or fabricated in steel; and the subframe, consisting of four members fabricated in steel, made up of two cross-beams (2) complete with jacking arms, and two side beams (4) carrying the road wheels (1). Ancillary equipment consists of a hydraulic jack (3), two lifting beams (6), wheel chocks (5), and a number of wooden pads (7). Propulsion is by an air-driven motor (9) having a six-stage epicyclic reduction drive to the road wheels (1). The motor can be detached when not in use.

The pallet, the side and cross-beams of the sub-frame and the jack, are all provided with lifting lugs and all the components, except the concrete pallet, can be handled with a 5 ton crane. The lifting beams are suitable for handling any member. The concrete pallet weighs about 9½ tons and can be handled by two lifting beams. The complete sub-frame with pallet may be lifted by the lugs in the side beams, using two lifting beams. Figs. 1 and 3 give details of the assembly.

OPERATING THE PALLET

Before being loaded, the pallet is lifted and positioned on the wooden pads (7) in Fig. 2, the cross-beams (2) of the sub-frame located under the ends of the pallet and another set of wooden pads placed under the cross-beams, below the lifting eyes. The side beams (4) of the sub-frame are then offered up to the ends of the cross-beams and locked in position with the gate plates. The jack is placed under the jacking point and each end of the assembly lifted in turn to a height that allows the wooden pads to be removed, after which the assembly is lowered on to its road wheels. After the pallet is loaded, the air tool is fitted and the assembly traversed to the required position in an adjacent bay.

The assembly weighs less than 20 tons and is designed to carry a safe working load of 100 tons at a traversing speed of 2½ ft per min. For satisfactory operation an air supply of 20 cu. ft per min at 100 lb per sq. in is required. If two air-drive units are used, the air consumption is doubled but the speed will not increase. The advantage of using two motors is in the additional torque that is available to overcome any local obstacles.

The floor loading is 150 to 200 lb per sq. in and it is desirable to have a floor that is reasonably level and free from rail-tracks or sliding-door guide channels. A practised slinger and crane driver can assemble (or dismantle) the chassis in 15 min.

APPLICATIONS ELSEWHERE

A mobile pallet of this kind is a most useful piece of equipment for use as a transfer unit between adjacent crane bays; as a means of developing an existing factory installation to handle heavier products; or as a means of moving large and heavy units into final position on site. In all cases, its advantage over other types of equipment is that it can be used without any particular preparation of the site, such as the laying down of rail tracks. For this reason, work can be rearranged and resited quickly.

Fig. 1 (above) The steel pallet on its wheels in the unloaded condition.

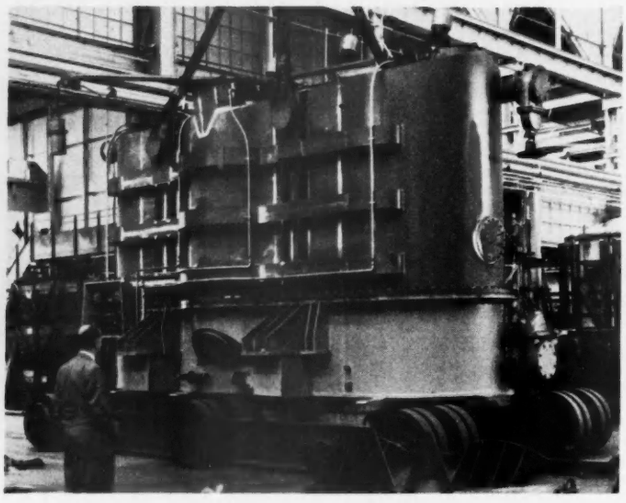
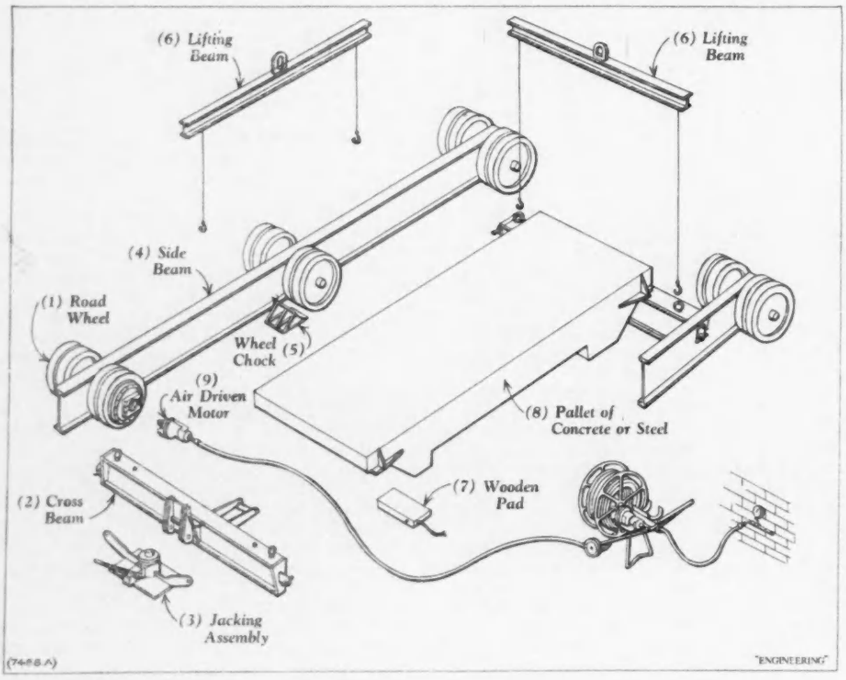
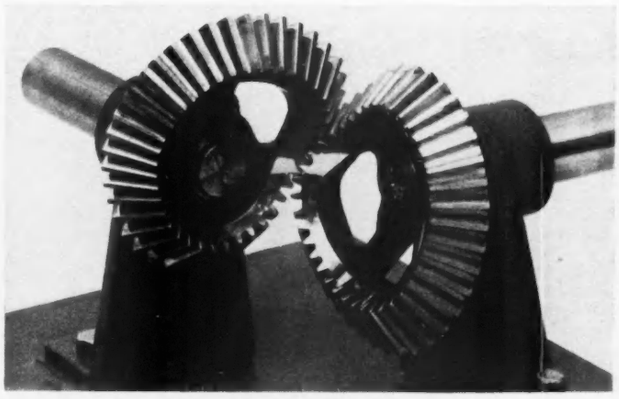


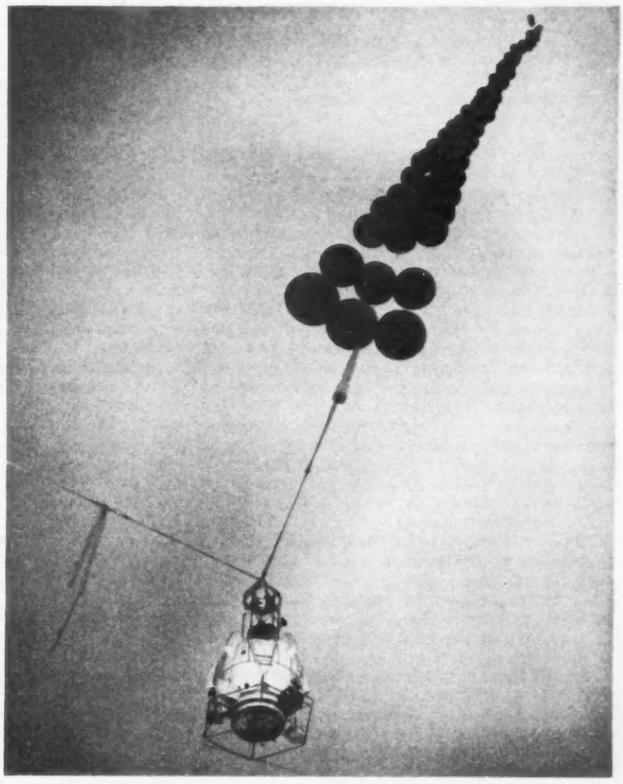
Fig. 3 (right) Three-quarter view of the transformer before the large capacity crane has removed it from the pallet.

Fig. 2 (below) Exploded view to show the main components of the mobile pallet and the way it operates.





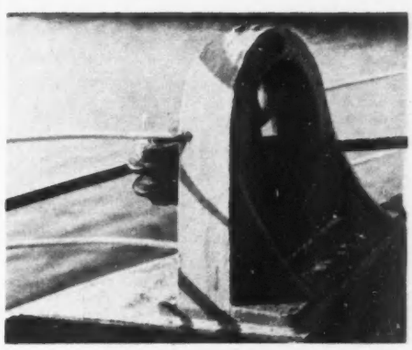
(*Above*) *These Swedish non-circular bevel gears, designed by Uno Olsson, are based on spherical conic section rolling curves.*



(*Right*) *Chain of polyethylene balloons used by Audouin Dollfuss, the French astronomer, to lift the gondola used for observation.*

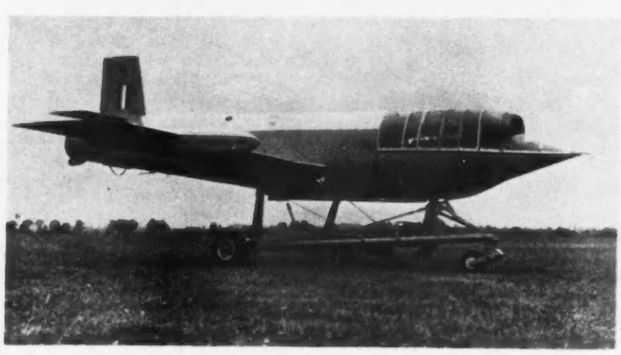
(*Left*) *Cab interior of British Railways 1,550 h.p. Bo-Bo diesel-electric locomotive D 6500.*

(*Right*) *Ford universal towing chock, a self-aligning fairlead, gives, among other things, a true angle from deck to shore mooring.*



(*Left*) *Aluminium is used extensively in the US army tank M 60 to reduce weight and increase the cruising range.*

(*Right*) *The use of welded aluminium saved about 1½ tons in this 16 cu. yd tipper body made for themselves by Amalgamated Roadstone Corporation Limited.*



(*Left*) *Jindivik Mk 2B, the near-supersonic pilotless target aircraft, designed by the Government Aircraft Factories in Australia for use in guided weapon trials at Woomera.*

Cooling Tower Uses Honeycomb Fill

Until now, cooling towers have operated on splash or film-flow principles. In a typical splash system, the water flows through an arrangement of wooden (or, more recently, plastics) slats, which break up the flow into droplets more or less haphazardly, while in the conventional film-flow system, the water flows in a smooth film over sheets of wood, metal or other suitable material.

A completely new type of tower, weighing less than half that of conventional towers of the same capacity, has been developed by Thermotank Limited, Helen Street, Glasgow. The saving in weight and size has been achieved by using a heat-transfer or fill material wherein the water is cooled by a current of air as it passes through closely spaced elements.

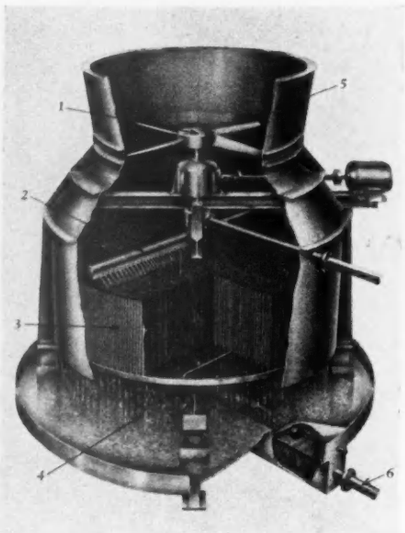
The tower, which is circular, is fitted with a top-mounted fan to draw the surrounding air up from the bottom. A honeycomb structure is used for the fill, arranged across the inside of the tower with the channels disposed vertically. The cooling air passes up through the channels, while water enters the tower at the top and is distributed across the surface of the fillI by a centrally mounted rotating header pipe that has a number of perforations along its length. The perforations vary in size along the length of the header, so that there may be even distribution of the water.

The material of the fill has a high wettability, that is, it is easily wetted, and the water passes down the walls of the channels in a thin continuously moving film. This ensures the maximum area of contact between the rising currents of air and the water, and so makes maximum use of the volume of fill. A catchment tray at the base of the tower collects the cooled water for return to the appliance for which it is required Initially, these Thermotank cooling towers are being made in twelve graduated sizes, the largest single-cell unit of which can deal with up to 90,000 gallons of water an hour, when the water is at 87° F on and 75° F off, with a wet bulb temperature of 68° F.

The fill is made from alternate flat and corrugated sheets of phenolic resin-impregnated cellulose material. It is made up into such rigid units that only a very light supporting structure is required at the base. The entire internal area of the tower can therefore be occupied by the fill without any need for bracing. Normally, a wettable material is mechanically weak, but the plastic impregnation of this fill imparts a high degree of wet strength, without sacrificing its absorbent capacity.

Two grades of fill are made, with two sizes of channel, the larger of which has a spacing of little more than $\frac{1}{4}$ in. Because of the large number of these channels per square foot, the fill presents an extensive cooling surface for the water to flow over, and because of the high wettability of the material, the water adheres to the walls of the channels, and allows a free passage for the upward air currents. Since the film of water is continuously maintained, any foreign matter remains in suspension in the water and is drained away, thus preventing choking of the narrow channels.

Since the elements are closely-spaced, the flow of air would be severely restricted by the accumulation of water at the base of the fill, if steps had not been taken to prevent this. Drainage from the bottom of the fill is accomplished by serrating the lower face (a patented feature). This breaks the capillary bond and allows the water to run easily off the tips of the fill.



1 Fan
2 Rotating header
3 Heat transfer elements
4 Catchment tray
5 Diffuser
6 Cooled water outlet

Friction Winder with Overhung Armature

An entirely overhung armature is being used in the new tower-mounted friction winders at Warsop Colliery, No. 3 area, National Coal Board East Midlands division. By so doing, it is possible to employ only two main bearings, and thus accommodate the deflection and distortion of the winder unavoidable in a steel-framed tower.

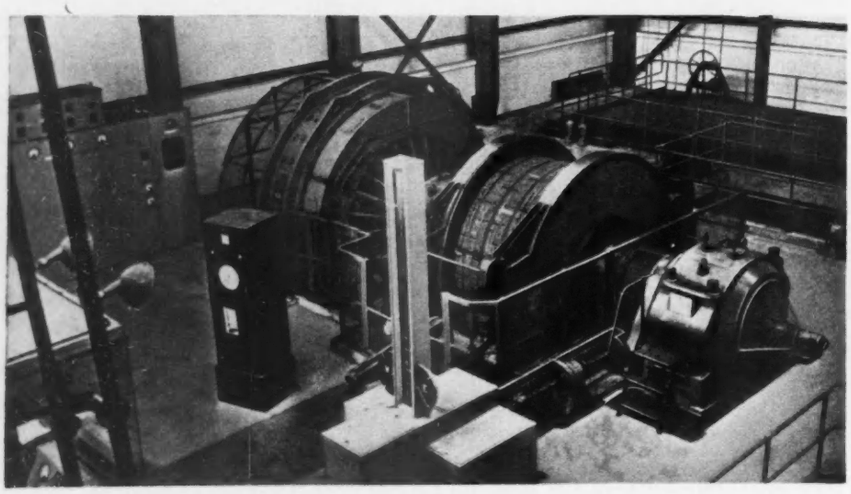
In No. 1 shaft, the cage-winder motor is rated at 1,334 to 1,940 h.p. at 78·4 r.p.m. In No. 2 shaft, where skip-winding is employed, the winder motor is rated at 1,638 to 2,120 h.p. at 77·2 r.p.m.; it was made by the Heavy Plant Division, AEI, at Rugby. Each has Ward Leonard control, with the laminated exciter closed-loop system. In addition to providing accurate speed control of the winder, this system sets a limit to the torque and acceleration imposed on the winder. The two motor-generator sets are situated at ground level, but the distance separating them from the winders is unimportant, since the high armature voltage makes light cables possible, and the small voltage drop is, in any case, compensated for automatically by the closed-loop control system.

A synchronous induction motor, rated at 830 to 1,124 h.p. at 750 r.p.m., drives the 840 to 1,537 kW motor-generator set supplying No. 1 shaft winder. A similar motor, rated at 1,165 to 1,263 h.p., drives the 1,071 to 1,678 kW, 750 r.p.m generator for the skip-winder motor. A change-over switchboard allows each of the winder motors to be supplied by either generator.

Men and materials are wound in No. 1 shaft, and coal exclusively in No. 2, which, from the arrival of the coal train at the tippling station underground to discharging at the top of the shaft, has an automatic winding system. Automatic operation depends on the flow of coal from the face. The arrival of the skip at the underground filling station operates a magnetic proximity switch which begins the sequence of operations by loading coal into the skip and then switching the flow of coal from the tipplers to the appropriate measuring pockets.

The control system permits automatic winding to be carried out continuously, and safeguards are provided, so that, in an emergency, the cycle of operations must be completed manually before automatic winding can be resumed. With the normal flow of coal, the skip is moved when it contains 8 tons of coal. If, however, the supply of coal from the working is very slow, the winding cycle is initiated after a pre-determined interval. Thus, in spite of a slow flow of coal from the face, an empty skip is frequently available at the shaft bottom. The operation is completely interlocked and must take place in the correct sequence before the winding cycle.

Because the suspended loads in the two shafts are dissimilar, so are the mechanical arrangements of the winders. In No. 1 shaft (1,338 ft deep), a two-rope winder is used with two-deck cages and a pay-load of 4 tons. The rope drum has a diameter of 11 ft and the cages are wound at a speed of 45 ft per sec. In No. 2 shaft a four-rope winder is installed with two skips, each of 8 tons capacity. The rope drum is of 8 ft 6 in diameter and so, although the direct-coupled motors on each equipment operate at almost the same speed, the rope speed in No. 2 shaft is only 35 ft per sec, giving an output of 400 tons an hour from the 1,421 ft depth. On both winders a positive pneumatic braking system is employed, which, in a simple and safe manner, performs the mechanical braking to the designed limits, irrespective of wear on the shoe lining. The brakes can be set to exert the correct effort for both normal and emergency operation when carrying out either normal winding or rope changing.



The Technical Problems of Broadcasting

Part 5 — Televising Internationally

By R. D. A. Maurice, Ing.-Dr., Ing.E.S.E., A.M.I.E.E., British Broadcasting Corporation

Television standards, that is the number of lines and fields that go to make up a television picture, differ from one nation to another. This necessitates a means of conversion whenever a television broadcast is made international.

Television broadcasting has grown from experimental transmissions by the BBC in 1929 in which the pictures were built up by means of 30 horizontal lines, through 180 line French transmissions in 1935, alternate 240 and 405 line transmissions by the BBC in 1936 and German transmissions on 441 lines in 1939. Today more than 40 countries have, or are planning the inauguration of, regular television broadcast programmes and the principle standards used are shown in Table I.

In each of these cases, two interlaced fields, one containing the odd-numbered lines and the other those of even number, make one complete picture.

The adoption of television services using different standards of lines (or fields, or both) at first made it difficult to exchange programmes between European countries. The United Kingdom was the first nation to broadcast a television programme originating in another country; in 1950 two outside broadcasts from Calais were arranged by the BBC, with the cooperation of the French broadcasting service. In these programmes, television cameras operating on British (405 line) standards were used, so that no problem of conversion arose. It soon became evident, however, that programme exchanges between England and France would necessitate the development of equipment to convert the signals from one standard to another. In 1952 a "standards converter" designed and built by BBC engineers[1] was installed at Cassel in Northern France, where French programmes on the 819 line standard were converted to the 405 line British standard, and relayed to London for transmissions over the BBC network. At the same time a converter working on the same general principles was developed by Radiodiffusion-Télévision Française (RTF) in France.

These first examples of the practical application of standards conversion were so successful that they were soon followed by others, and improved equipment was developed in this and other countries. Converters are now installed at Tolsford Hill (near Dover), Paris, Milan, Cologne Bussum in Holland and La Dole in Switzerland. The existence of such equipment has rendered possible the creation of the Eurovision television network. This comprises wide-band cables and radio links by means of which programmes may already be exchanged between 16 television services in 12 different countries. The greatest distance that has been spanned in this way was between Algiers and Scotland, where viewers were able to see events taking place during the crisis of the Fourth Republic. This programme was not fully planned in advance and demonstrated the power of television to capture the spirit of events as they occur. Fully organised Eurovision transmissions have been received, converted and rebroadcast from as far as Rome and Stockholm.

The development of the Eurovision network and the practical arrangements for the often complicated programmes that are now frequently exchanged between countries in Western Europe is the responsibility of the European Broadcasting Union. The programme plans are coordinated by the administrative office of the Union in Geneva and the technical arrangements by the Technical Centre in Brussels, which operates an International Technical Coordination Centre there; at this Centre technical supervision of all except the simplest exchanges is carried out and the switching of the vision, sound, and control lines is performed.[2 3 4] In the USA television programmes are also transmitted over immense distances, but this does not involve changes of television standards and, therefore, does not require the interposition of standards conversion equipment en route.

TABLE I.—*International Standards*

Nation	Lines per picture	Fields per second (interlaced)
United Kingdom	405	50
France	819	50
Other European countries	625	50
USA	525	60

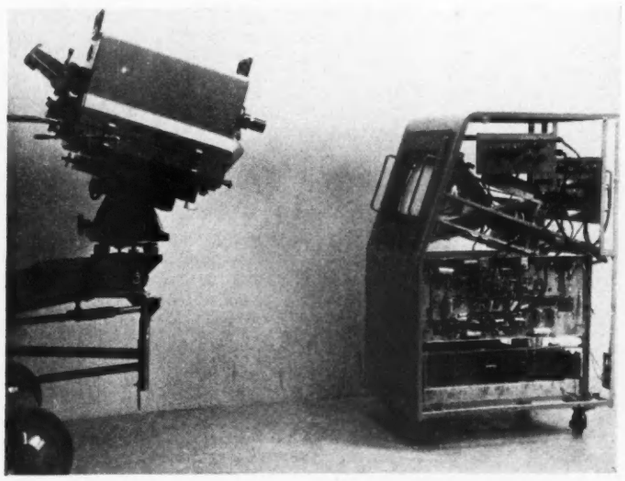


Fig. 1 (left) An early type of standards converter. A television camera, working on the standard of the receiving country, is simply trained upon a receiver which works on the standard of the transmitting country.

Fig. 2 (below left) The extent of flicker when converting between television standards having different field frequencies.

Fig. 3 (below right) Modern type of standards converter, installed by the BBC at Tolsford Hill. It is capable of converting 819 lines or 625 lines to 405 lines (British standard).

ENGINEERING ASPECT

Although many methods for transforming television signals from one scanning standard to another have been proposed[5 6], only one has so far proved of practical value. This is an

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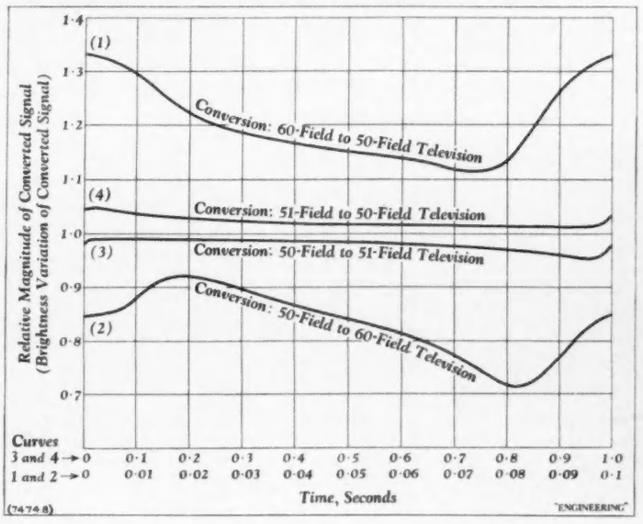

adaptation of the rather simple idea of taking a "photograph," by means of a television camera operating on the scanning standards of the receiving country, of the image appearing on the screen of a cathode-ray display tube operating on the scanning standards of the country of origin (Fig. 1).

All phosphors used as screen material for cathode-ray display tubes exhibit persistence, or afterglow, so that an area of screen excited into fluorescence by the electron scanning beam, which is modulated in intensity in accordance with the variations of picture signal, continues to emit light after the scanning beam has passed. If this afterglow were such that the initial brightness of a scanned area on the screen were maintained until the same area was re-scanned during the succeeding frame or picture, the displayed image would maintain unvarying brightness except for movement in the scene; thus the television camera focused on the display screen would treat the picture as if it were a normal optical image. The only remaining problem would be that of the production of interference patterns by the "beating" between the lines of the incoming image with those produced by the "reading" electron scanning beam on the target in the pick-up tube of the receiving camera. These interference patterns are easily eliminated by spot position modulation or spot wobble, in which, to the relatively slow vertical movement of the "writing" beam in the display tube is added a very rapid vertical motion of just sufficient magnitude to eliminate the horizontal line structure of the displayed image.

In practice, the afterglow of the phosphor does not possess quite such a desirable rectangular shape, as a function of time, and the emission of light from a scanned area fades gradually over a short period. If it fades too rapidly a component of flicker at a frequency equal to the difference between the field frequencies of the two television standards will appear as a modulation of the converted signal. It will readily be understood that if, for example, the field frequency of the incoming signal to be converted is lower than that of the converted signal, there will be repeated occasions during which the reading beam in the camera tube will scan an area of the target that has not yet been replenished by a new writing scan. Such an area will have a lower electronic charge than on other occasions. The smaller the afterglow, the greater will be the ratio of maximum to minimum converted signal. On the other hand, if the afterglow persists too long, each read signal will contain information from previously written frames and errors of movement such as are common in cinema films will arise.

FLICKER THEORY

If the transfer function of a display-tube phosphor, expressed as the luminous response to a unit-impulse bombardment of electrons, can be expressed by a linear differential equation with respect to time, it can be shown that the light emitted will fade in accordance with an exponential law. If the duration of a single picture element be small compared with the decay time of the light and this picture element be repeated at intervals equivalent to one field period, the emission of light from it can be expressed in terms of a Fourier series.

Modern low-velocity (reading) beam camera tubes may be regarded as operating in accordance with the photographic reciprocity law: that the intensity of the latent image (on a negative) is the product of the luminance and length of exposure.

Lord's[1] assumption that the dimensions of the reading beam in the receiving camera tube are such that the electronic-charge image on the target due to each field written on to it from the display tube is completely discharged by each field of reading scan, enables the exposure period to be clearly determined. It is simply the duration of one field of the television standard in force in the receiving country. The picture element which has just been considered will cause an electric charge to be stored on the camera-tube target and the converted television signal due to this picture element will be proportional to this stored charge. This, in turn, depends upon the integrated luminous flux issuing from the picture element on the display tube during one field scan of the camera. The converted signal will, therefore, be proportional to the time integral of the Fourier series taken over this field period. The number of harmonics in the Fourier series which it is necessary to include should be chosen bearing in mind that the eye's sensitivity to flicker becomes insignificant at frequencies exceeding approximately 30 c/s.

If, for simplicity, only the fundamental term of the integrated series be considered, it can be shown that there is a term of uniform signal (or brightness) equal to the ratio of the duration of the field of the converted signal to that of the signal to be converted, to which is added a sinusoidal component of flicker whose magnitude depends upon the same ratio and whose frequency of recurrence is equal to the difference between the two field frequencies. If the conversion is between television systems having identical field frequencies, the amplitude of the flicker component is zero. The magnitude of the flicker is found to diminish with increasing afterglow.

Table II shows some examples of the extent to which flicker can arise using a display-tube phosphor having a decay constant sufficiently small so as not to introduce serious errors when movement occurs in the scene to be televised. Fig. 2 shows the extent of the flicker in the form of brightness variations as a function of time. It will be seen that conversion between the UK standard and Continental standards having the same nominal field frequency can be satisfactorily achieved, whereas conversion between the UK and US standards presents greater difficulty because of the difference in field frequency (which results from the use of 60 c/s mains in the USA against 50 c/s in the UK).

TABLE II.—*Examples of Standard Conversion*

Example of conversion	Duration of a field of signal to be converted (seconds)	Duration of a field of converted signal (seconds)	Afterglow: time taken for light to decrease by 63 per cent (seconds)	Total variation of brightness (signal) as percentage of mean brightness	No. of curve in Fig. 2	Number of harmonics contributing to visible flicker
US to UK standard	1/60	1/50	1/200	18*	1	3
UK to US standard	1/50	1/60	1/200	24*	2	3
Continental Europe to UK standard (field frequencies to necessarily exactly equal) or vice versa	1/50	1/51	1/200	4·1†	3	30
Continental Europe to UK standard (field frequencies not necessarily exactly equal) or vice versa)	1/51	1/50	1/200	3·9†	4	30

* Intolerable. † Insignificant.

A method of overcoming this difficulty of conversion between UK and US standards was suggested in 1953 in the article already mentioned.[1] More recently, improved means have been devised for reducing the flicker and work is proceeding on the development of converters incorporating these improvements. Such converters are required when television pictures recorded on magnetic tape are exchanged between the USA and European countries, and will become of even greater importance when live transatlantic television becomes possible.

Fig. 3 shows the standards conversion equipment[7] installed by the BBC at Tolsford Hill. It is capable of converting signals from 819 lines, 50 fields (nominal) or 625 lines, 50 fields (nominal) to 405 line, 50 fields (nominal). Conversion from 405 lines, 50 fields to 625 lines, 50 fields, is also possible. The apparatus includes two separate channels and uses the latest image-orthicon cameras with 4½ in targets.

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[3] M. J. L. Pulling. "Eurovision Technical Operations: A Survey," *ibid.*

[4] H. A. Laett and Enzo Castelli. "Picture Quality on Long Television Chains," *ibid.*

[5] A. Cazalas. "Problème de la Transformation des Standards de Télévision," *L'.Onde Eléctrique*, 31e annee, No. 289, Avril, 1951.

[6] V. K. Zworykin and E. G. Ramberg. "Standards Conversion of Television Signals," *Electronics*, USA, January, 1952.

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This is the last in this series of articles, which have appeared at fortnightly intervals.

Effect of Radiation on Electronic Equipment

There has been a growing need, particularly in military applications, for electronic equipment that will withstand nuclear radiation for prolonged periods. Although considerable experimental data relating to radiation effects on electronic components now exists, much of it has been obtained under widely varying conditions so that one set of data cannot always be directly related to another.

In order to overcome this problem research workers at the Bendix Aircraft Corporation, USA, have compiled a list of radiation-effect data, collected from all available sources, and have attempted to interpret and rationalise the information. In this way they are able to classify many individual components in a relative manner so that an estimate can be made as to which particular component in a given circuit is most likely to fail under prolonged nuclear radiation.

Most of the information on the Bendix file relates to "off the shelf" components and it is interesting to note that Bendix report differences of several orders of magnitude in the radiation resistance of various manufacturers products.

Even when a particular component is not listed on the file it is still possible to make use of the information. For instance, if a particular type of valve has not yet been radiation tested, some useful degree of selection can still be made through the knowledge that large valves and boron glass valves have a strong tendency to fail. Consequently any such choice would be guided towards a subminiature valve with no boron content in the glass.

To estimate the practical value of this new means of component selection an experiment was carried out by Bendix in which a military aircraft marker beacon receiver was made with selected components. After 370 hours of exposure to fast (epicadmium) neutrons, the unit was still operating within pertinent military specifications. This is believed to represent an improvement (in radiation resistance) of two orders of magnitude. Further work is being done towards a more complete classification of components and several electronic systems have now been designed with components selected in this manner.

Taking the Measure of Research and Development

Few people deny that research has value. The arguments occur when an attempt is made to put a firm figure to that value. Often, for instance, the question arises as to whether the money spent in different fields of research bears any relation to the value of the results. On a national scale the problem might be whether expenditure on space research is commensurate with that on other types of research. Or difficulties can arise within an industrial concern when attempts are made to allocate funds to a range of projects that promise varying and sometimes unforeseeable returns. Many of the arguments put forward on such occasions are fallacious.

A session on methods and difficulties of measuring research effort was sponsored by the US National Science Foundation and the American Statistical Association and the papers read during the session have recently been published under the title *Methodology of Statistics on Research and Development*.

By 1957, United States expenditure on research had risen to $10,000 million per year, although the significance of this figure is not—as is pointed out below—clear. The National Science Foundation, established in 1950, was specifically directed, among other things, to develop a national policy for the promotion of basic research in science. This task was further clarified in 1954 by an executive order from the President: "The Foundation shall continue to make comprehensive studies and recommendations regarding the Nation's scientific research effort and its resources for scientific activities . . . and appraising the impact of research upon effort and its resources for scientific activities industrial development and upon general welfare." By 1958 the Foundation had conducted several surveys and felt that it had reached the point in its programme where it might be profitable to invite individuals acquainted with the programme and having related experience to discuss it and offer criticism. Hence the joint session with the ASA.

At the meeting, Mr. W. H. Shapley of the US Bureau of the Budget discussed the problems of definition and interpretation of research and development statistics as they related to spending by the Department of Defense. He pointed out that on the basis of published reports, such as those of the National Science Foundation, it could be claimed that the expenditure on military research and development for 1959 was $2,200, or $2,400, or $3,300, or $6,200 million. This is pretty strong evidence of the need for clarity of definition. Also it shows why critics and defenders of research programmes make much use of budgetary figures to support their arguments. Whatever the point of view, a convenient figure is generally available somewhere. "It is not surprising," remarks Mr. Shapley, "that the ultimate result, even for the serious student, should be one of pretty complete frustration."

"The relevance and usefulness of budgetary statistics on research and development are not particularly direct," he added. "Indeed the importance of understanding the problems of concept and definition is chiefly negative, that is, to help one avoid drawing from budgetary statistics policy inferences which appear obvious but which in fact turn out to depend on implicit assumptions which deserve more critical examination."

A major problem is distinguishing between research and development on one hand and procurement and production on the other. Substantial amounts in the $3,000 million that go for production of aircraft, missiles, and other items of equipment under development and for use in development, test, and evaluation activities are both procurement and development. The two are not mutually exclusive categories.

Nevertheless a feeling of uneasiness results from study of the overall figure. Would it not be possible to pick out the amount spent on "research," or the direct cost, and draw the line between this and "development," or indirect cost? On examination, the need for this differentiation is generally seen to stem from a feeling that what is needed is a financial measure of the level of scientific activity or research effort. But in Mr. Shapley's view the search for a more restrictive category of budgetary statistics to meet this need is almost certain to be futile. For such purposes it is often preferable to use manpower statistics rather than budgetary ones.

Costs of research and development programmes do not always relate to the economic benefits obtained. Very expensive developments may fail, while major economic benefits may result from new products or techniques that cost little. And although expenditure may be a necessary condition for scientific achievement, it is certainly not a sufficient condition. As for the value of research and development—even if it could be measured in budgetary terms there is no reason to expect that it would correlate with its cost. Similarly, financial analysis will not reveal balance of effort between different programmes.

Mr. Shapley concludes that major efforts at detailed refinement of budgetary statistics on research and development do not appear to be warranted, and the use of such statistics as exact yardsticks in studies of research and development or its economic implications should be approached with caution.

The heavy demand by US industry for research and development statistics was pointed out by Mr. K. P. Sanow of the National Science Foundation. Scientific personnel statistics have proved valuable in foreseeing potential restrictions to research and development planning Frequent inquiries are received by the Foundation from industrial officials who want to compare the level of their own company research expenditure with that of their industry and size-group.

Mr. Sanow gives a review of the statistics on industrial research and development since 1920. Present surveys are providing more detailed and comprehensive data than the early series, which were tied to personnel totals reported in industrial laboratories. But there are still problems of definition, accountancy, and variable response. A fortunate trend is that respondents are becoming accustomed to surveys and have in some cases adapted their accounting systems to show research and development expenditure with greater clarity.

The difficulties facing the research and development statistician were summed up by Helen Wood of the US Department of Labor. By way of comparison she pointed out that erroneous replies in employment surveys are still widespread—though minor and offsetting—despite decades of work on such programmes. The difficulty of discovering the number of employed workers—obviously a much less amorphous and elusive concept than research and development costs—shows the problem facing any statistical surveyor in the field of research and development.

Versatile Distillation Simulator

Designed at the Research Centre of the British Petroleum Company Limited and manufactured by Winston Electronics Limited, Shepperton, Middlesex, the BP free-standing atmospheric and vacuum distillation apparatus was developed originally for the distillation assay of crude oil. It has since proved to be a versatile unit for a wide range of laboratory distillation work in organic chemistry, particularly in the petroleum and solvents field.

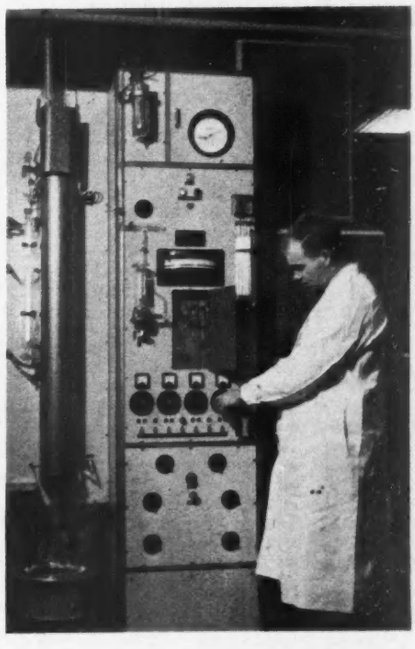
As its name implies, the apparatus is suitable for use at both atmospheric and reduced pressures. Light gaseous components can be handled in the liquid phase by circulation of suitable refrigerant in the condenser and receiver system. Provision is also made for metering non-condensible gases.

The normal charge to the unit is 4 litres, which enables a sufficient quantity of each fraction to be obtained for subsequent analysis and refining treatment. The dimensions of the standard column are 36 mm internal diameter, 1,370 mm length and 1,220 mm packed length, the standard packing being stainless steel boot eyelets which gives a plate efficiency of 14. Alternative packings can be supplied to suit requirements and, in special cases, to considerably increase the plate efficiency, The column operates under adiabatic conditions.

In assay of crude oil it is possible to obtain complete data by means of pilot or small-scale equipment in which the essential features of the large-scale refinery unit are duplicated. Such methods are, however, costly and most designers of plant prefer a more general type of assay which involves a true boiling point distillation and the preparation of yield data and curves of the significant properties of the distillate fractions.

The BP 14 plate distillation equipment gives a sufficient degree of fractionation to enable this data to be obtained. Narrow boiling fractions can be analysed separately or blended in aliquot proportions to produce a number of possible refinery specification products for analysis. The residue from the distillation can be utilised to prepare a series of residues of differing cut point by back blending with the distillate fractions. Alternatively the residue can be distilled further in a high vacuum still to obtain lubricating oil and bitumen fractions. Such a subsidiary still is now being developed.

Since basic yield data is required in most processes employing or reducing organic liquids, it is believed this equipment will have a far wider application than the petroleum laboratory and refinery control work for which it was originally developed.



Better Washing

Two new washing machines have recently come on the market: the English Electric Liberator, a chief feature of which is control of the automatic cycle, and the General Electric Double-Plus which caters for large or small washes. Both incorporate heaters and spin dryers.

The Liberator, shown in the first illustration, is fully automatic and has a revolving drum, the clothes being loaded from the front. It has the great advantage over many of the earlier automatic machines in that it does not have to be fixed to the plumbing system of the house, but has its own 2·75 kW heater. Connection to the cold water supply is by a rubber hose and

The Liberator is a fully automatic machine in which the washing cycle can be varied to suit the fabric.

the machine can be mounted on a castor base to enable it to be moved out of the way when not in use. Alternatively, of course, it can be connected to the hot water system, which would reduce the heating-up time for the water and so the overall time of the wash.

On the right of the nameplate is the control panel. There are two controls, one a horizontal revolving cylinder that has on it the types of wash (such as " high temperature wash—white cottons and linens ") each being marked with a number; and a dial marked with corresponding numbers. In operation, the cylinder is first set to the wash required, according to the fabrics involved, and the dial set to the same number. The cycle is then started by pulling the control dial outwards. After that the sequence is entirely automatic until the clothes are ready for removal after spin drying. The full cycle is: a 12 minute pre-wash in cold water (only used with badly soiled garments such as overalls); a hot wash (duration and temperature to suit the fabrics); four rinses (reduced to three for delicate fabrics); and spin drying (omitted for synthetic and very delicate fabrics). The spin drying can also be used alone.

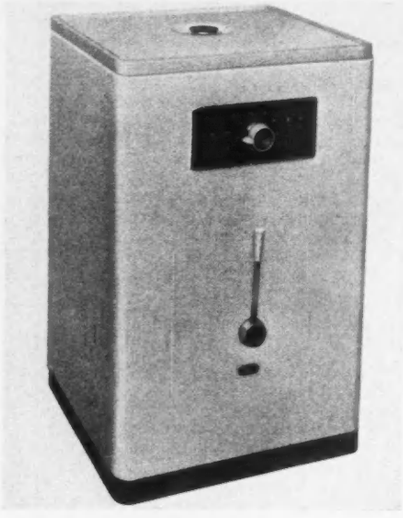
Clothes are loaded into the machine through the transparent door in the front. The capacity is 6½ lb of dry clothes. A safety feature is incorporated in the handle of the door, which can be removed when the door is closed rendering it safe against children's fingers. In the centre of the door is a screw port that allows the addition of detergent after the cycle has been started. The washing can be stopped at any time by pushing in the control knob and subsequently re-started by pulling it out again. About 4 gallons of hot water are required for each wash load.

Power can be obtained from a 13A plug and the drum is driven by a ½ h.p. motor with a belt transmission to step down the speed from 1,425 to 60 r.p.m. for washing, or 500 r.p.m. for spin drying. The change is a sliding sheave mechanism operated by a solenoid. Emptying is carried out by a centrifugal pump. The discharge hose has a curved end that hooks securely over the edge of the sink.

The 2·75 kW heater is a tubular sheathed immersion element which will raise the temperature of the water to 140° F in approximately 25 min. Switching on and off is controlled by the cycle controller and there is also a switch operated by the water level in the drum. A thermostat in the sump controls the temperature. The timer unit is electrically driven and is mounted with the motor overload protection for easy access.

Drum and container are of pressed steel welded construction, and finished in vitreous enamel. The cabinet is sheet steel, welded, and finished in stove enamel. The overall width of the machine is 25 in, depth 22 in and working top height 33½ in. The addition of the castor base (the castors are retracted during operation) brings the height up to 36 in. The weight is 234 lb.

The second machine—the GEC Double-Plus—has the unique feature of twin pulsators mounted at the bottom. This results in an unusual shape for the tub but also enables a small wash to be carried out if there are only a few clothes. Otherwise the machine has a very large capacity. It is also said that the arrangement ensures that there are no dormant corners in which clothes can lie unagitated. The spinner drum for rinsing and spin drying is tapered and has no perforations in the wall so that all the rinse water is forced through the clothes to the bottom of the drum before escaping. A smooth wall prevents imparting the crimped seersucker



The Double-Plus has twin agitators and incorporates a spin dryer. It can be used for large or small washes.

appearance to nylon and synthetic fibres resulting from being forced into the holes in a perforated drum during spinning.

Water for a maximum load is 11 gallons but as little as 5 gallons can be used for the small wash. A 3 kW heater will boil the water if desired. Overall dimensions of the machine are 32 in high by 21 in wide and 24 in deep. It does not need to be permanently connected to the house plumbing but is filled and emptied by hose. The tub is vitreous enamelled and the controls include a time switch and switches for the heater and motor. Quiet operation is a claim.

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Telegrams: Engineering Lesquare London.

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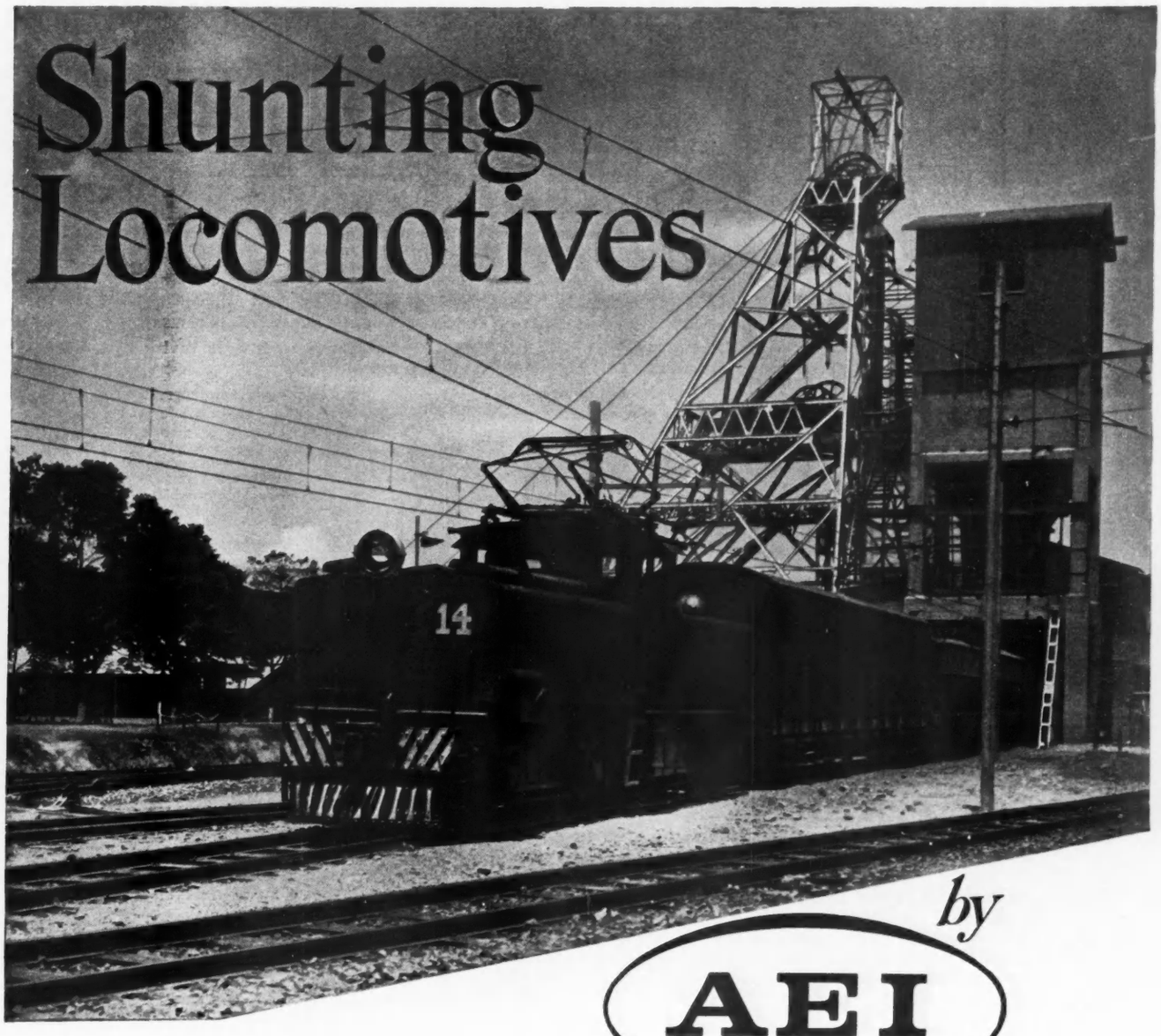

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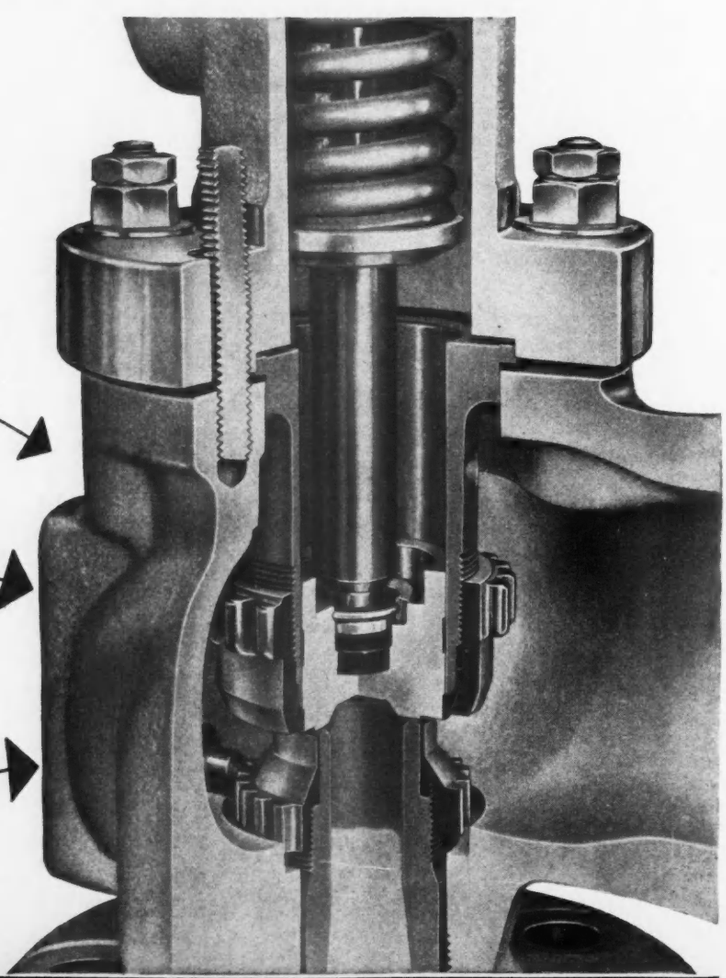

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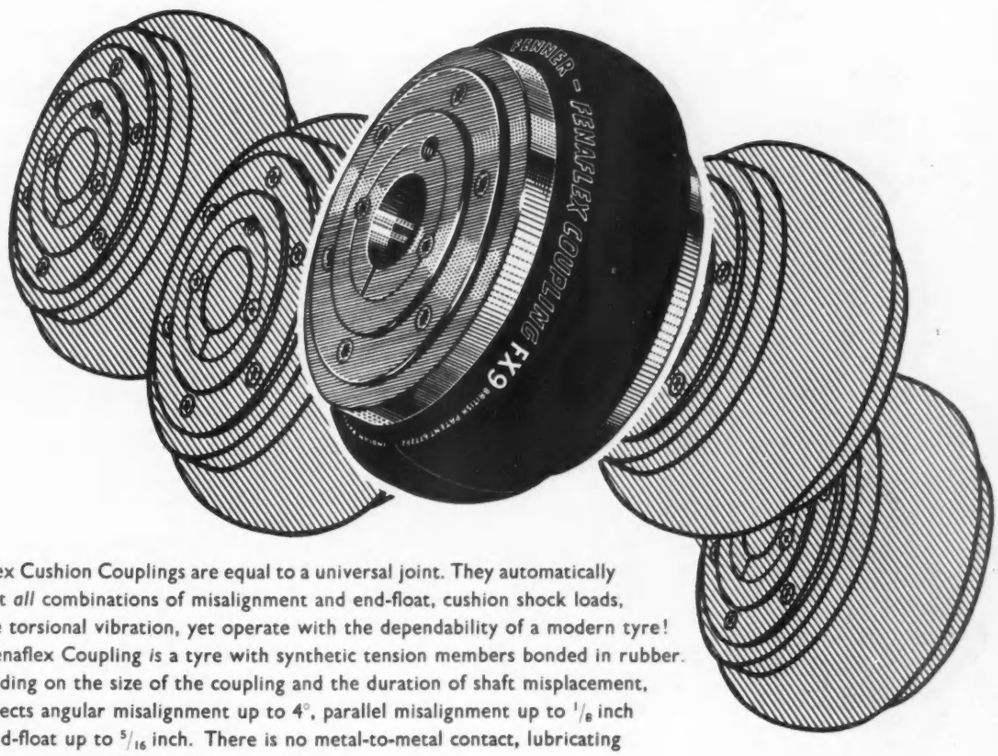

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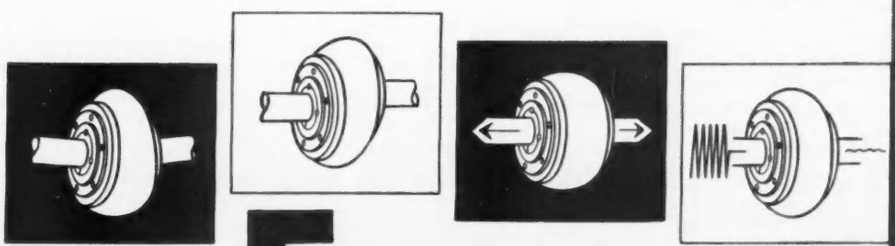

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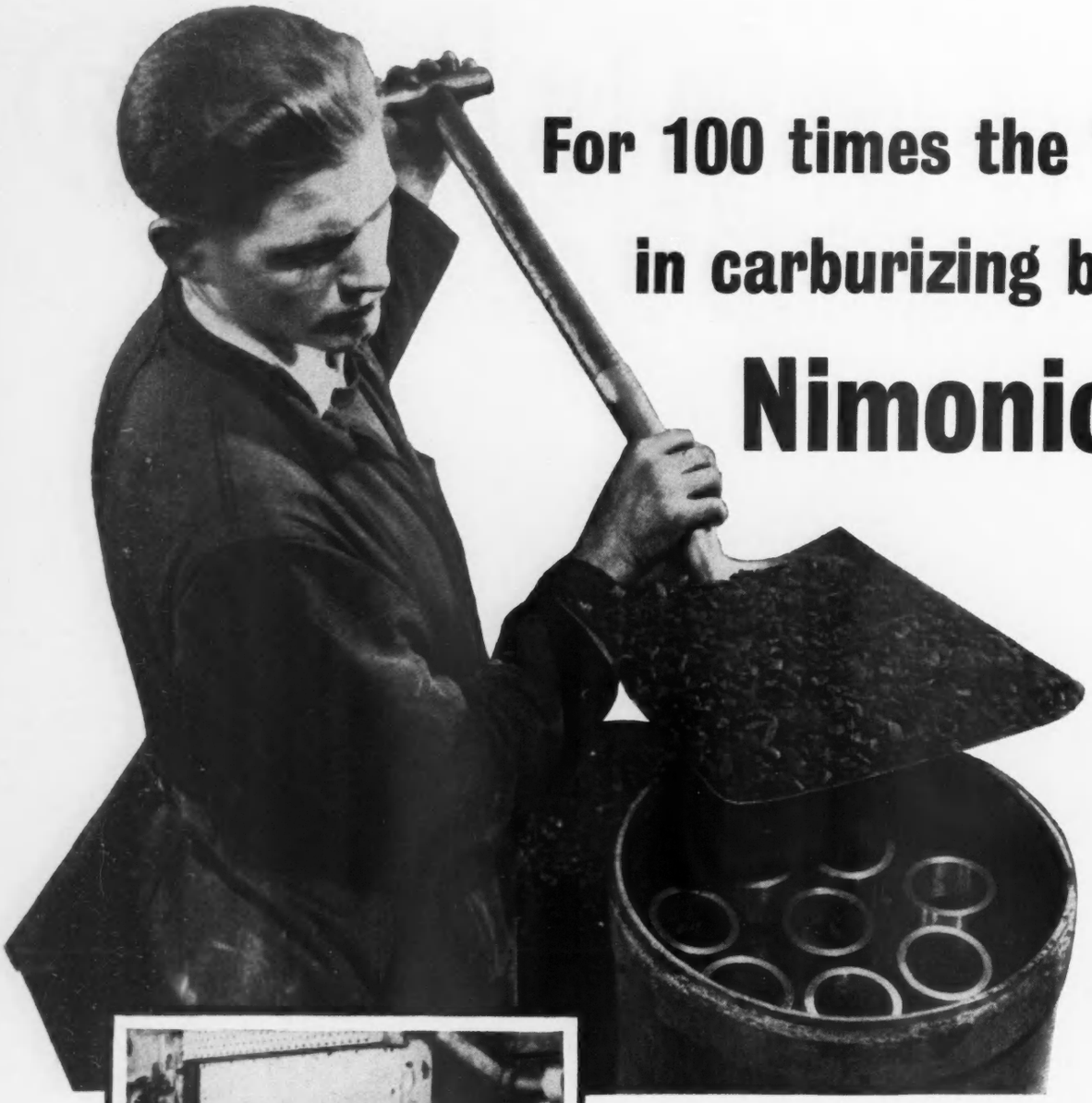

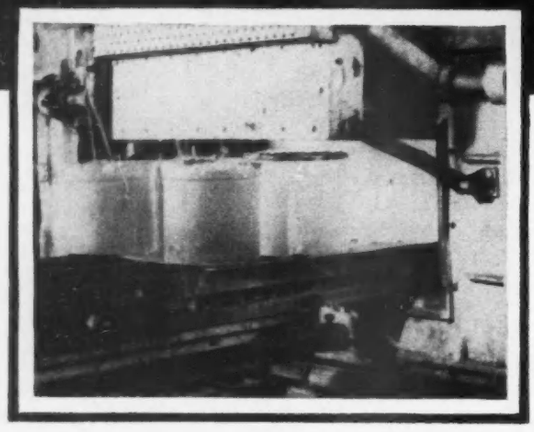

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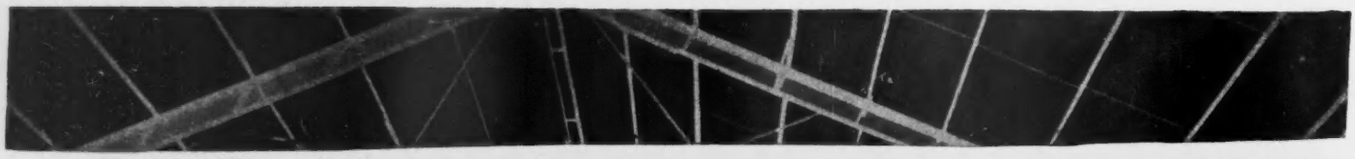

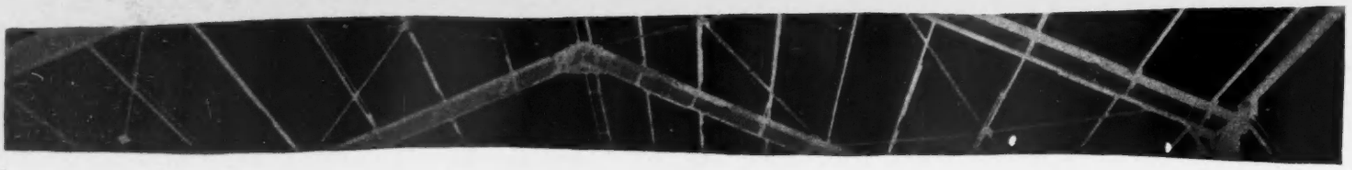

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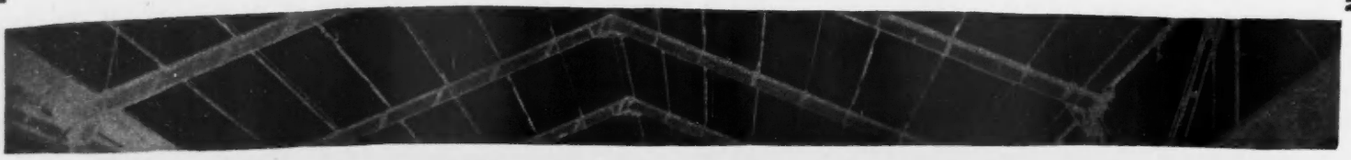

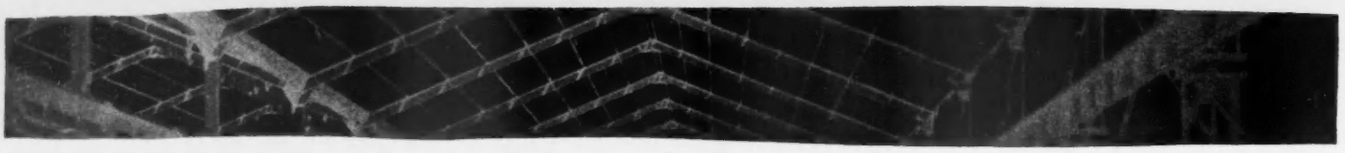

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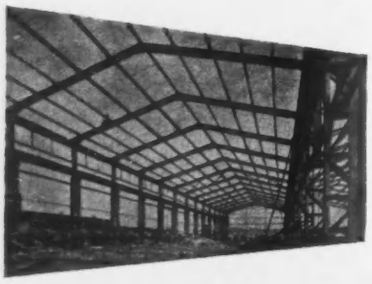

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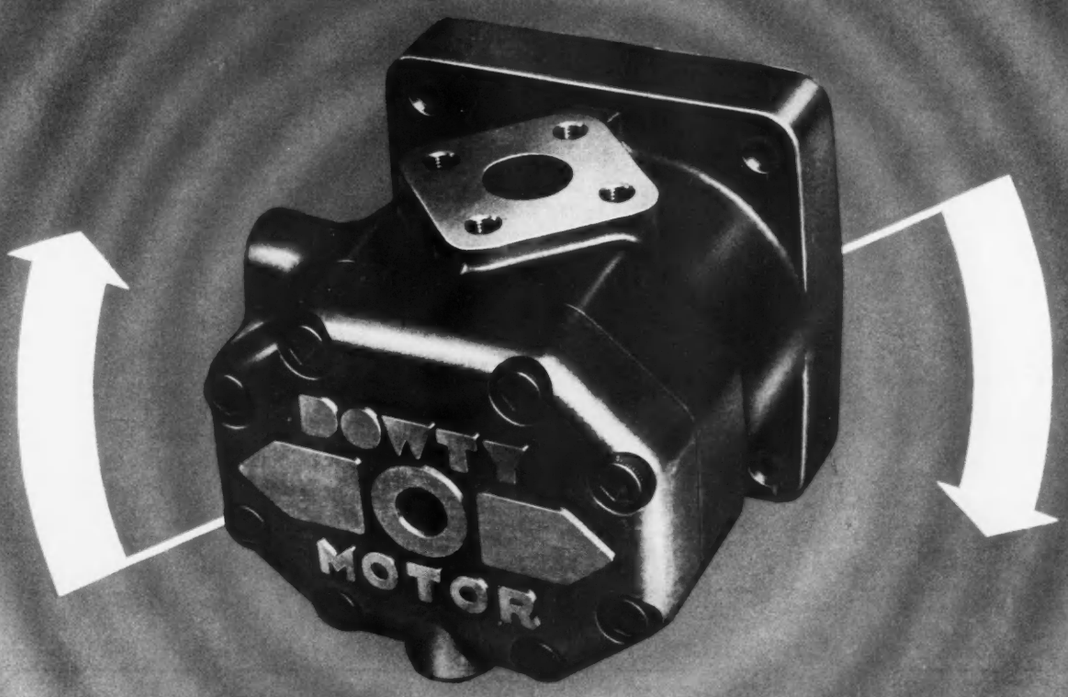

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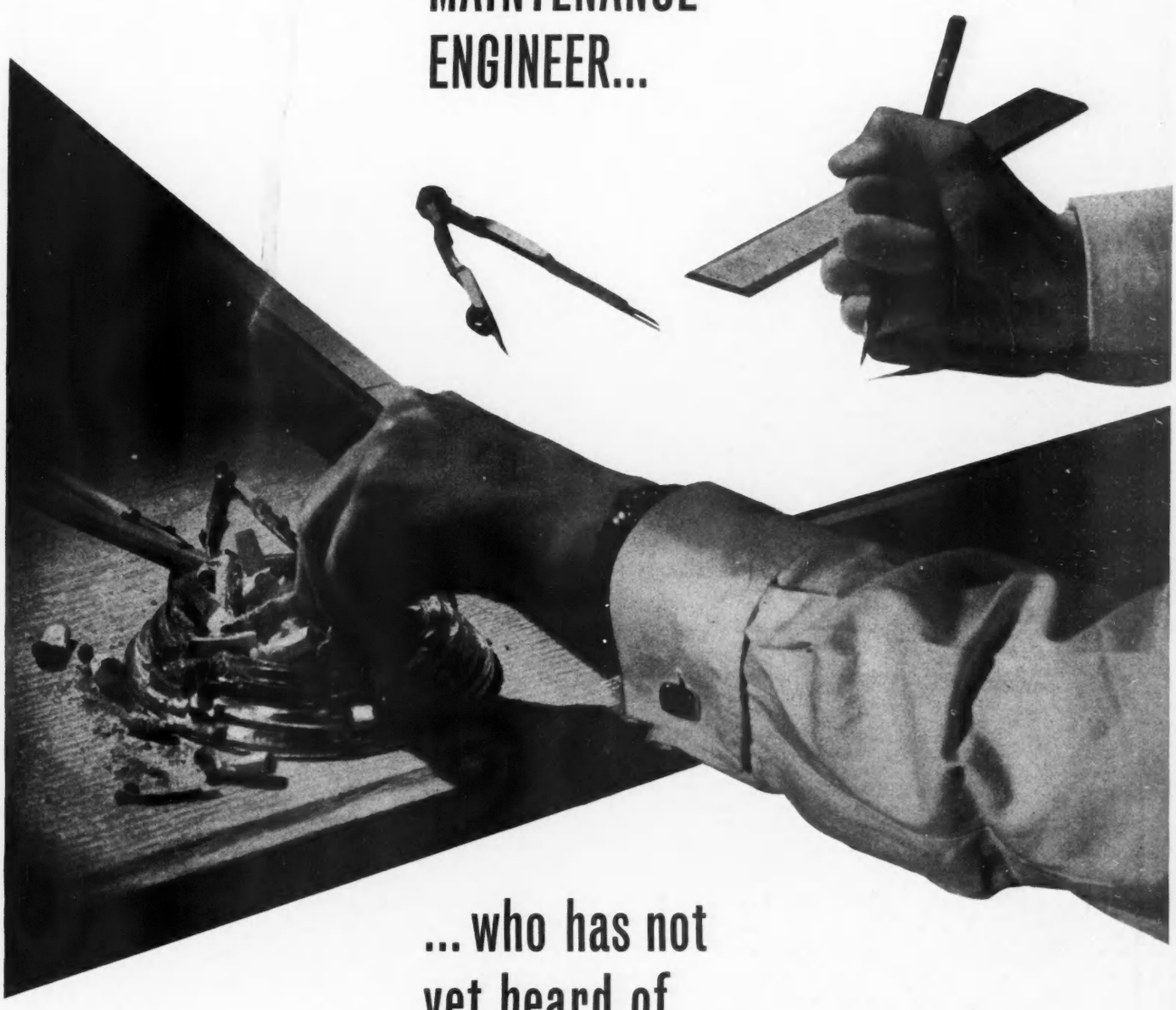

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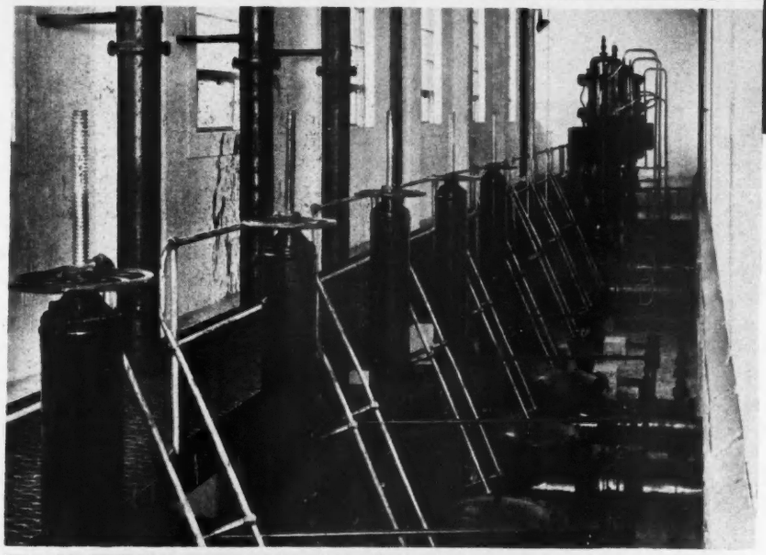

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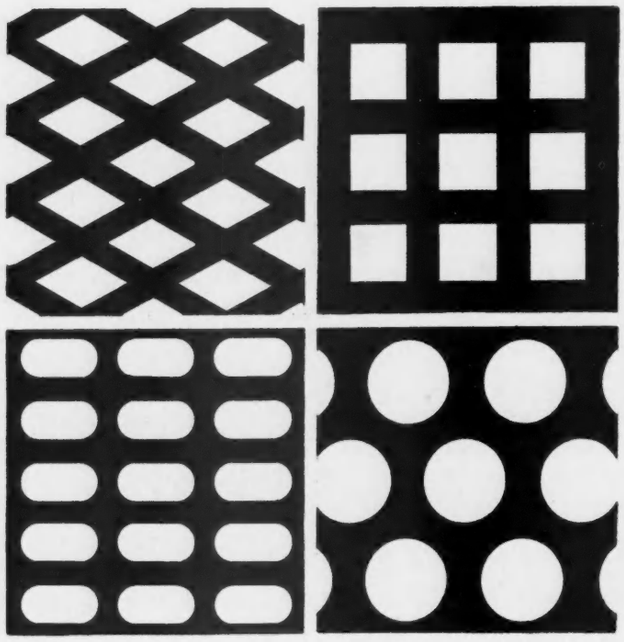

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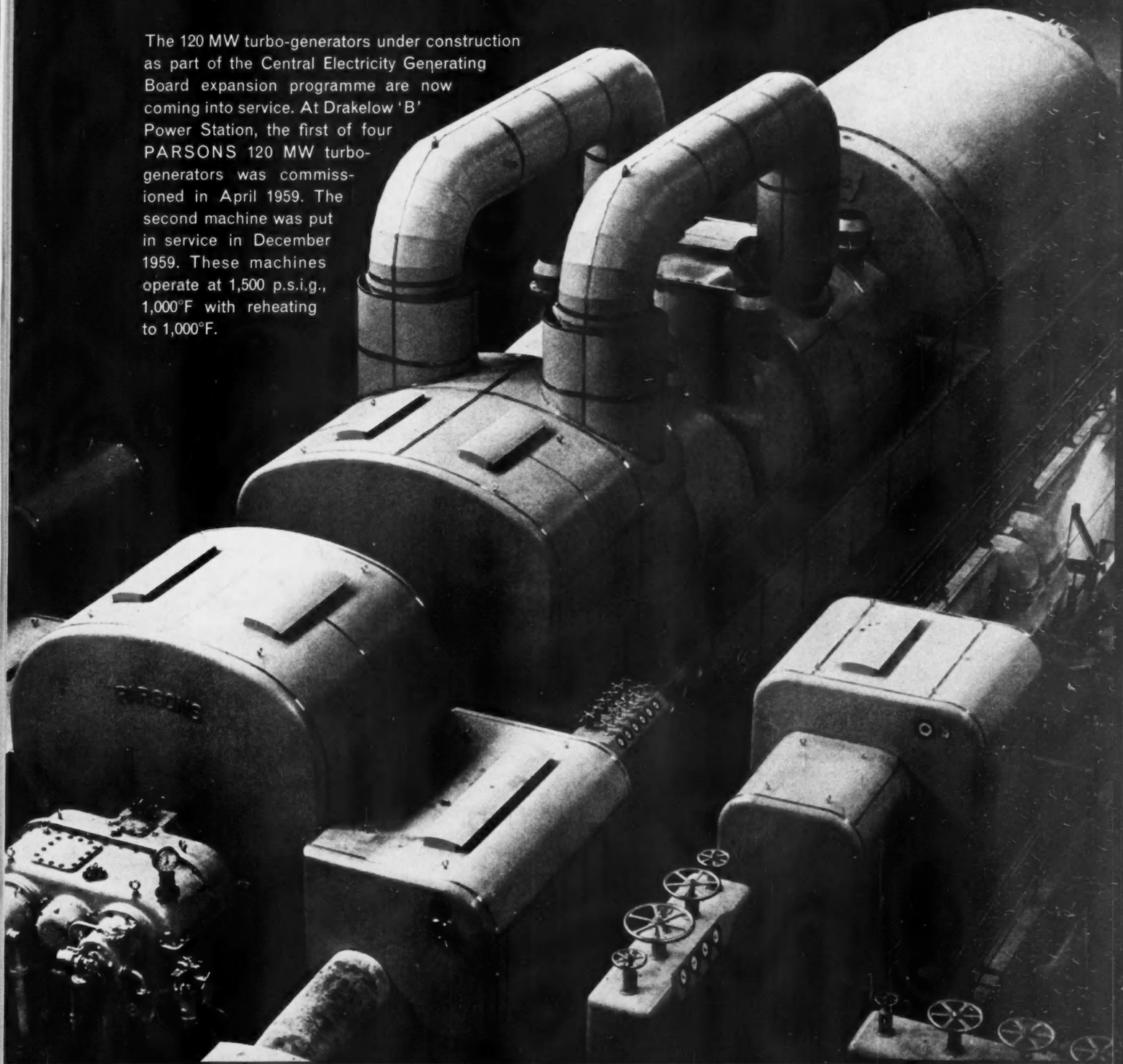

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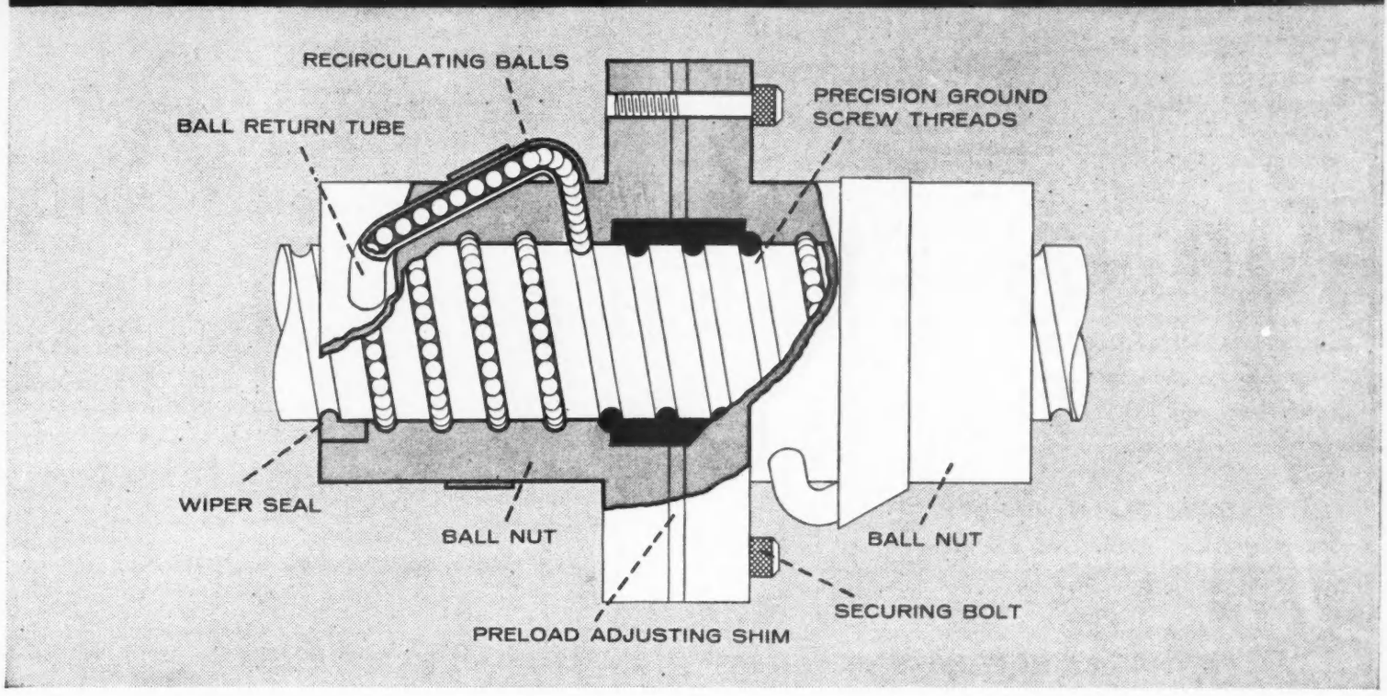

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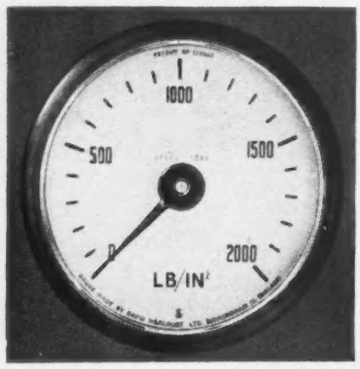

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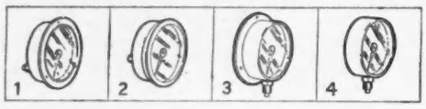

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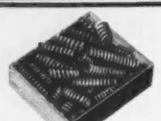
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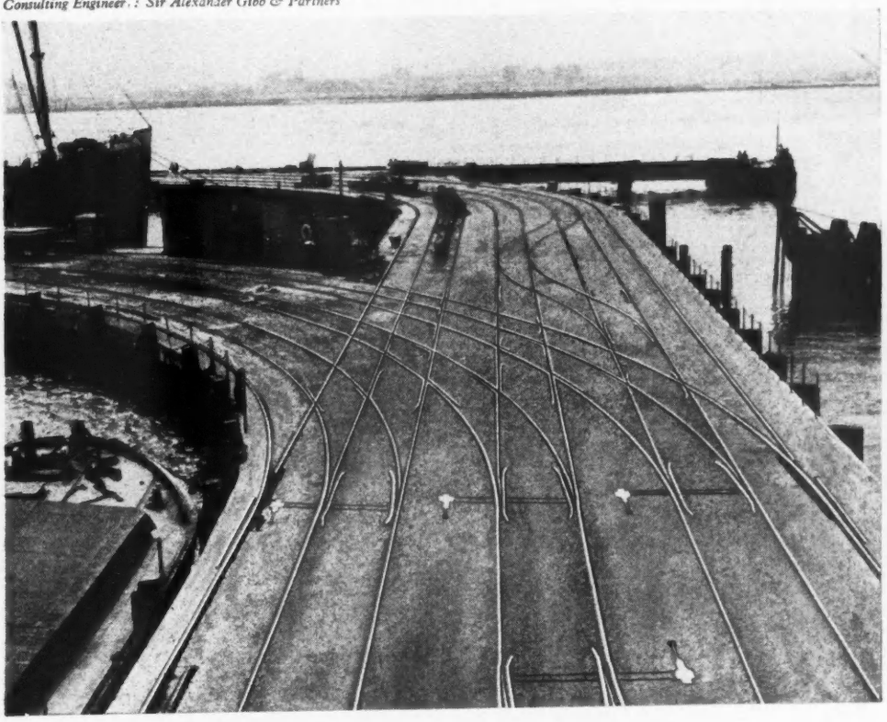

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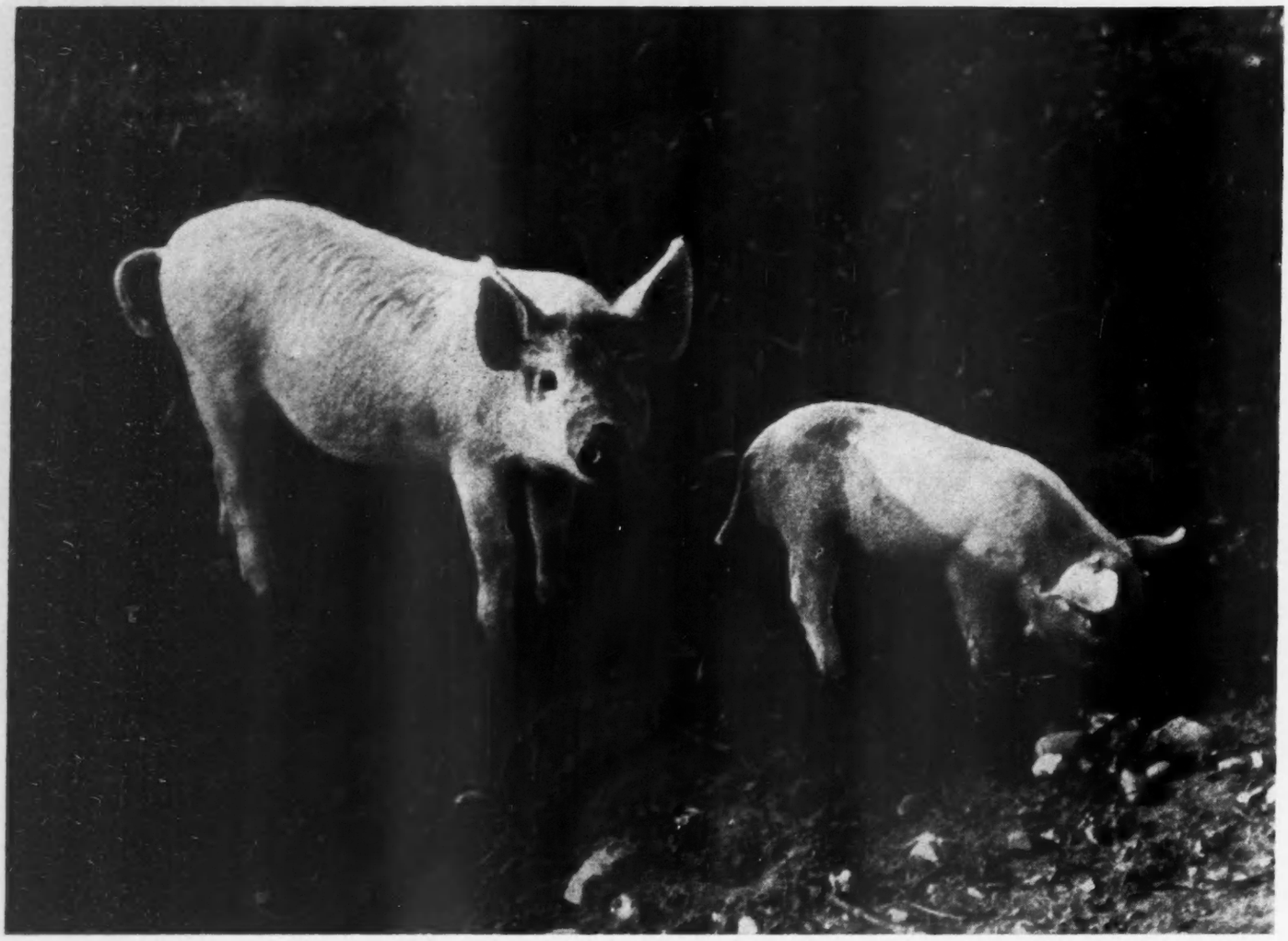

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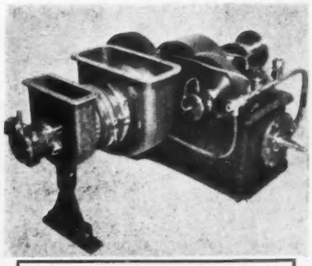
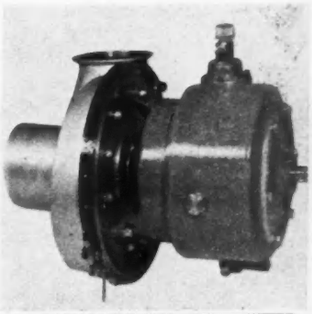


350 H.P. Turbine for Gasifier



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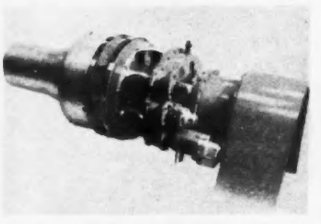
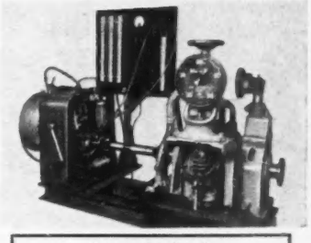


500 H.P. "Basilisk" Gas Turbine (Shaft Power and Air Bleed versions)



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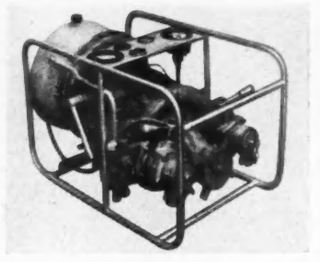
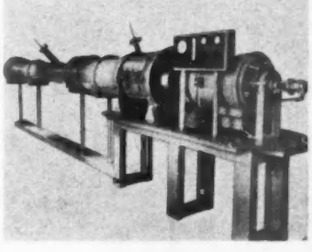


Axial Flow Compressor for Instructional Use



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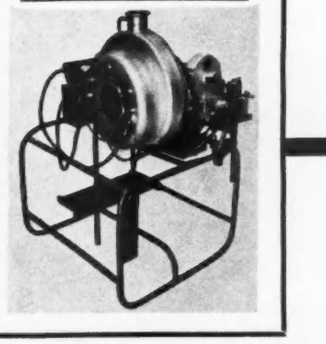

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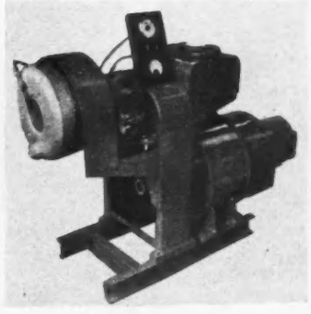

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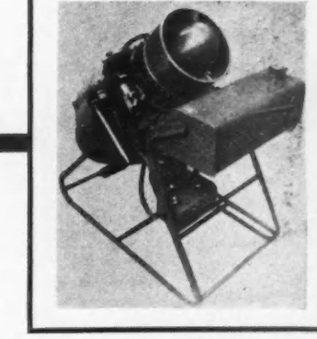

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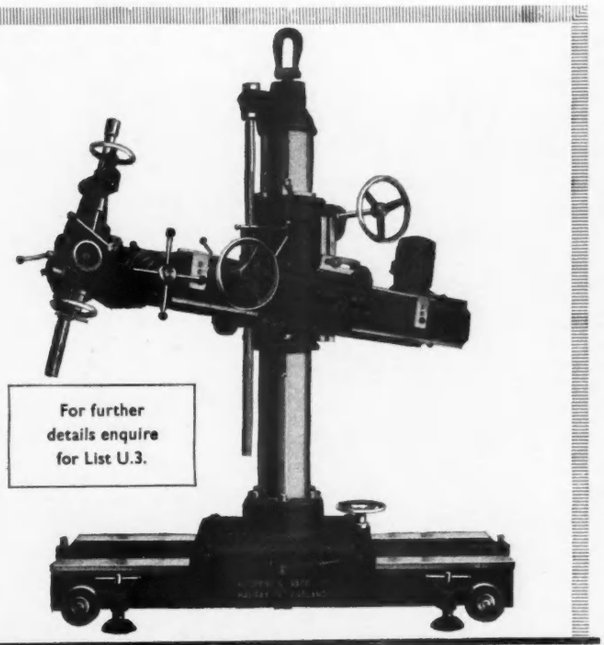

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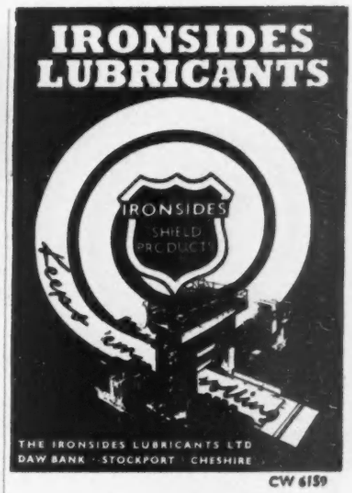

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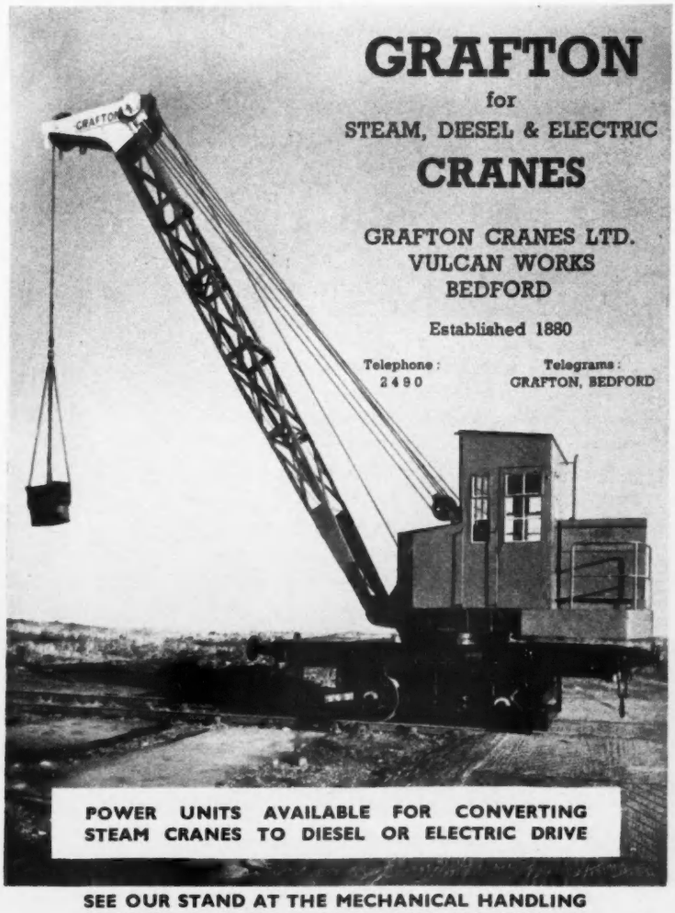

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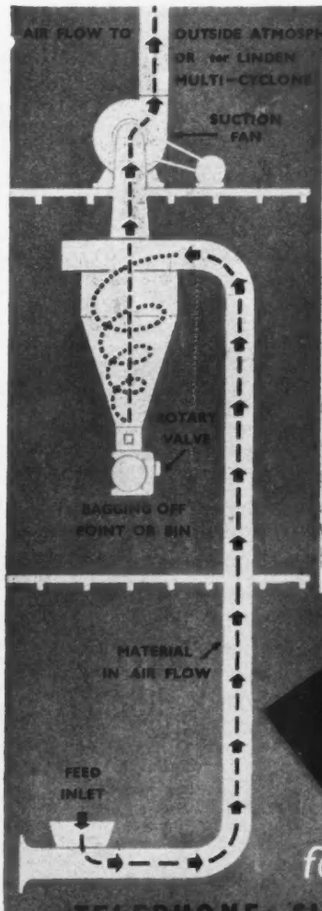

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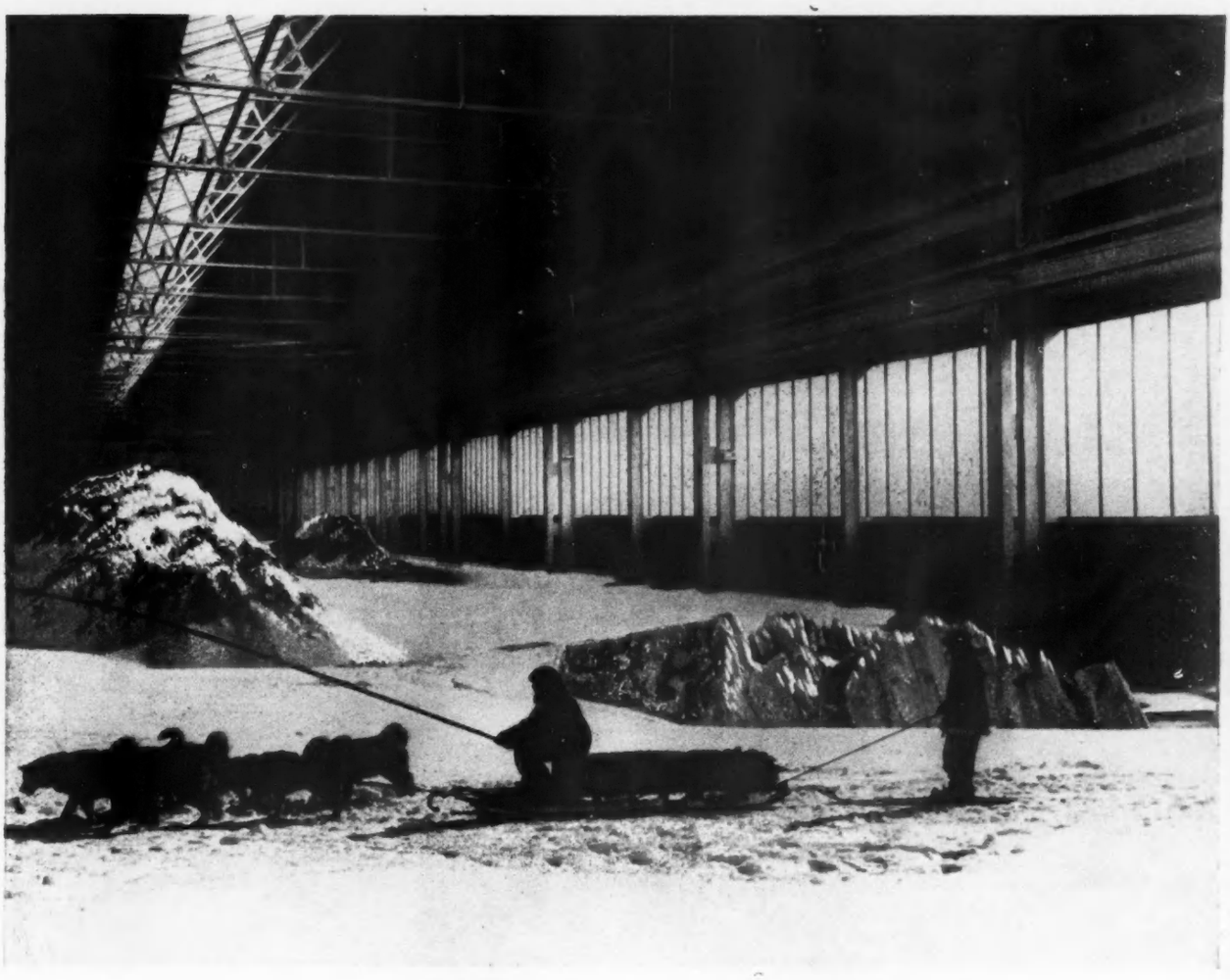

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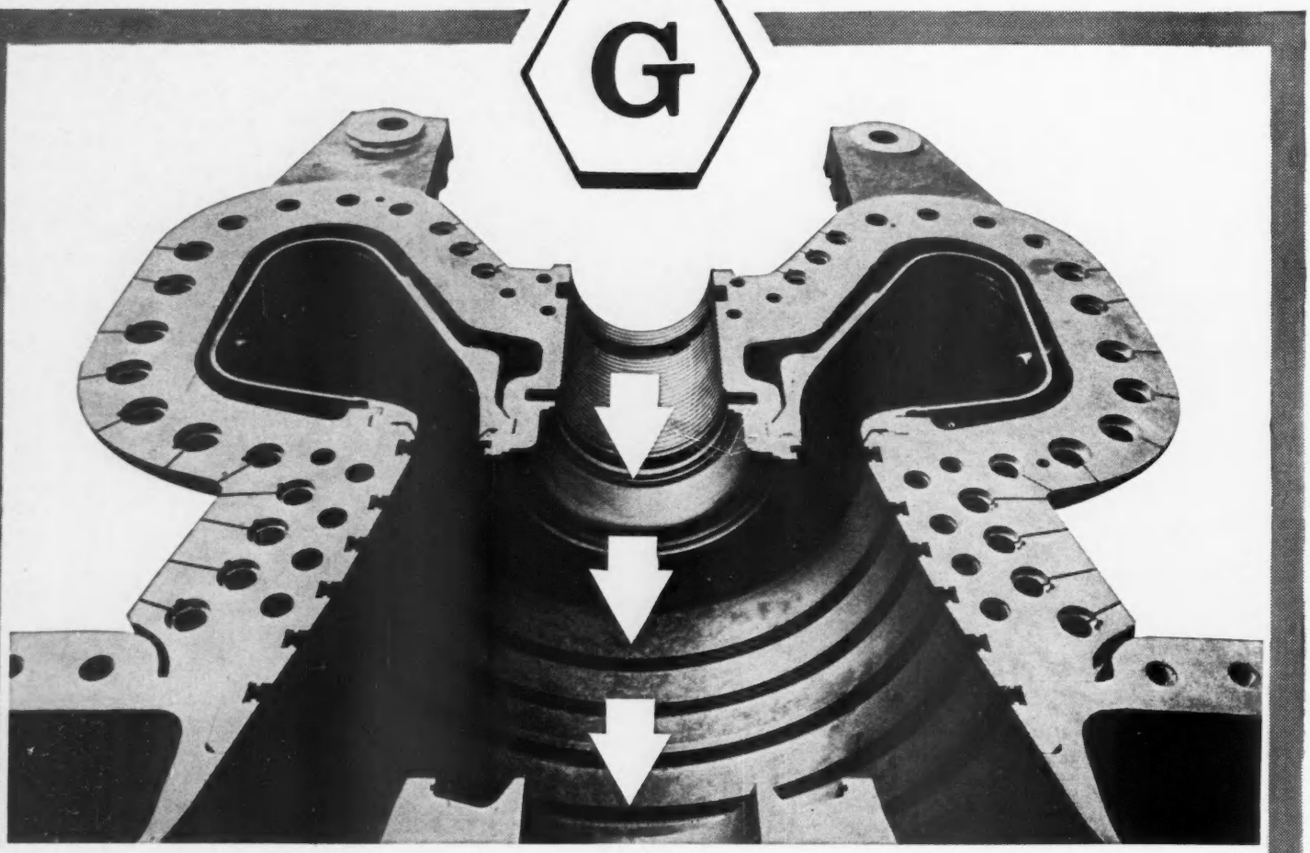

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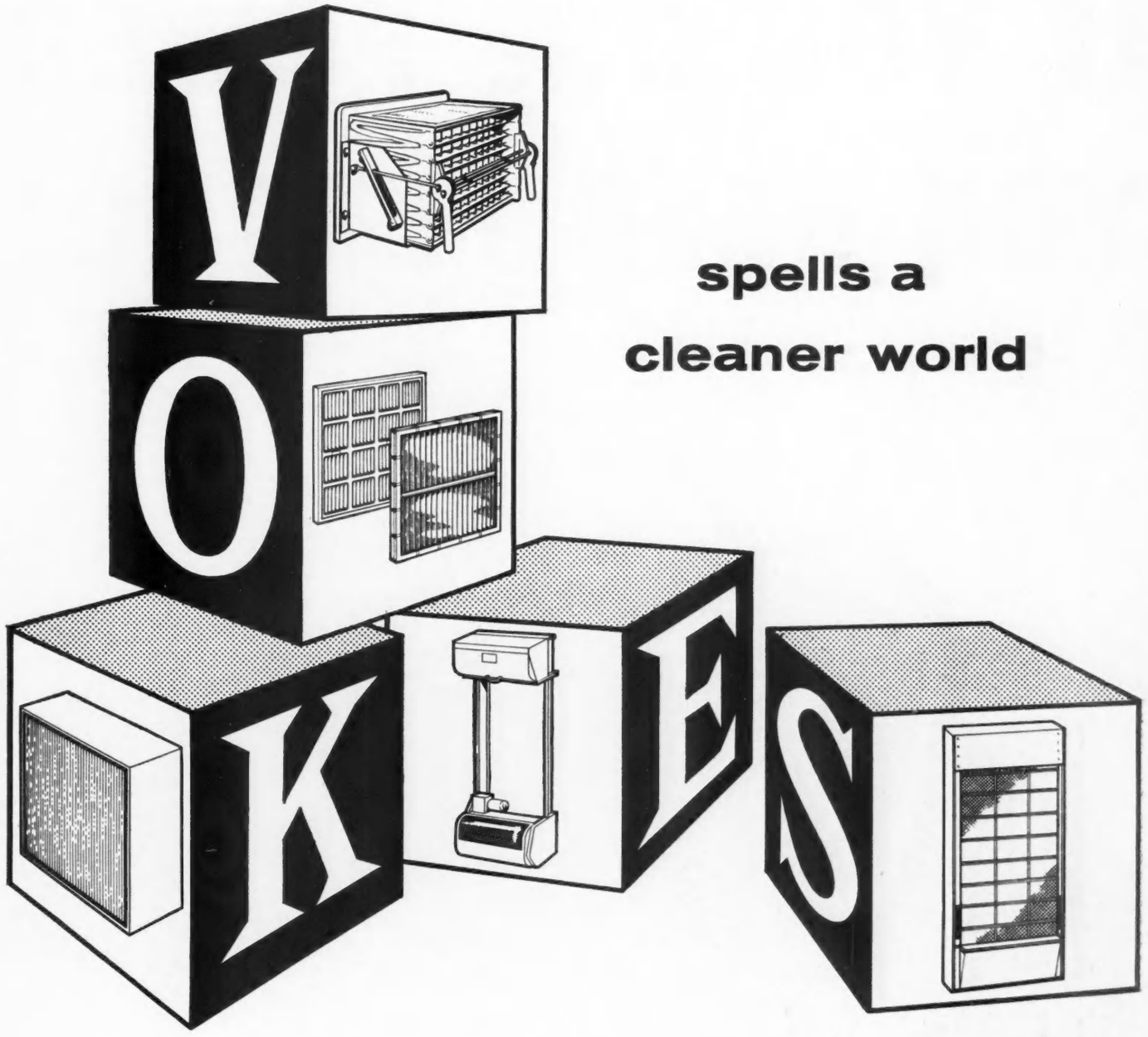

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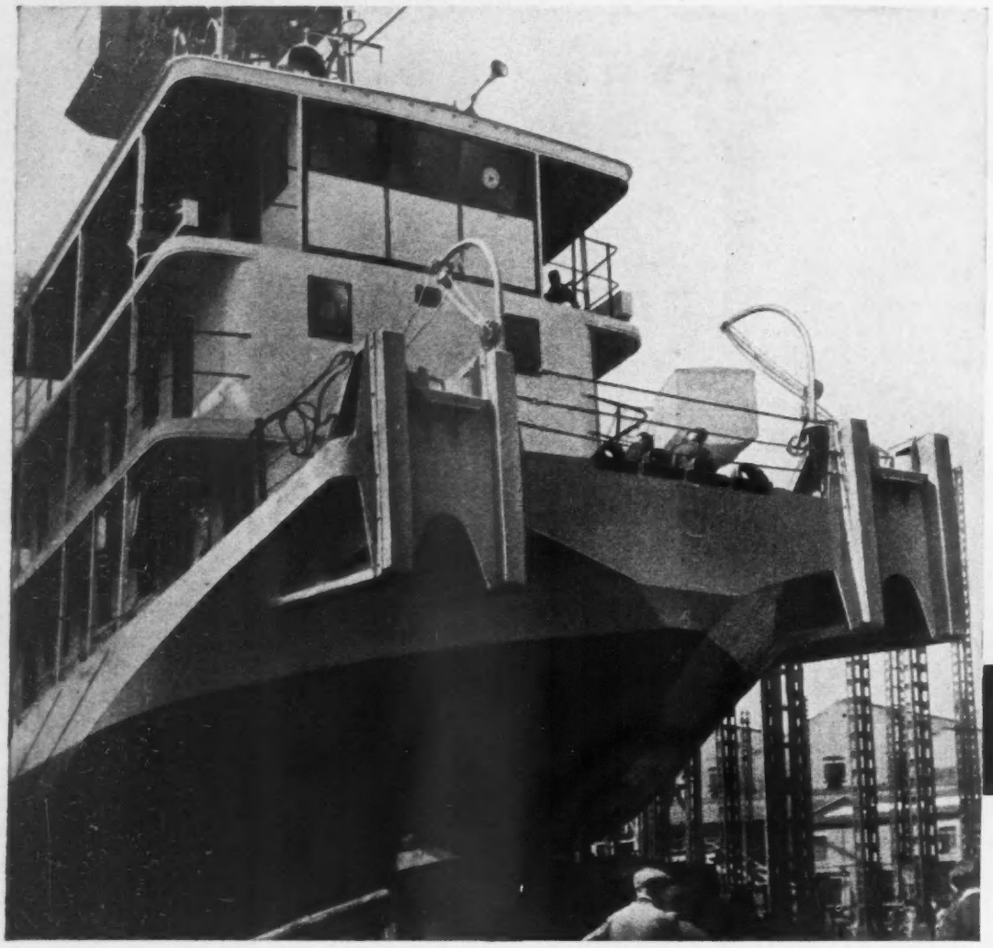

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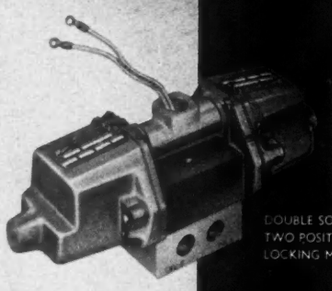

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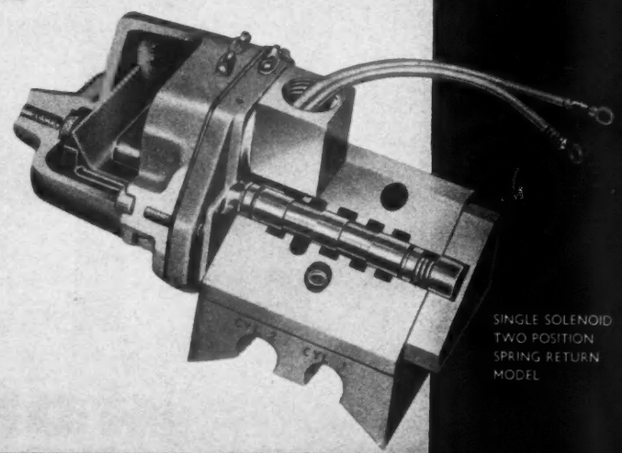

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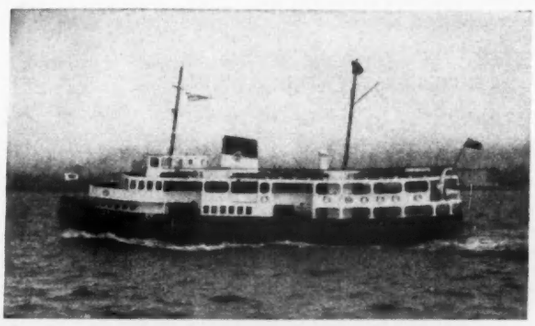

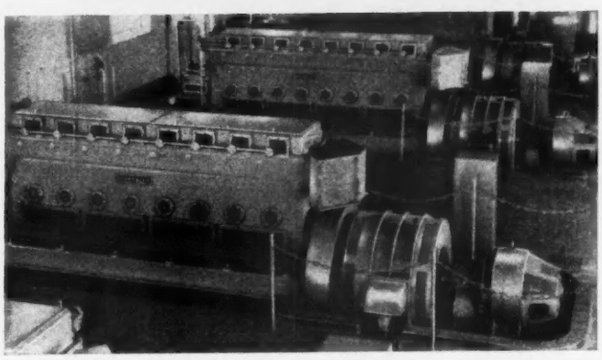

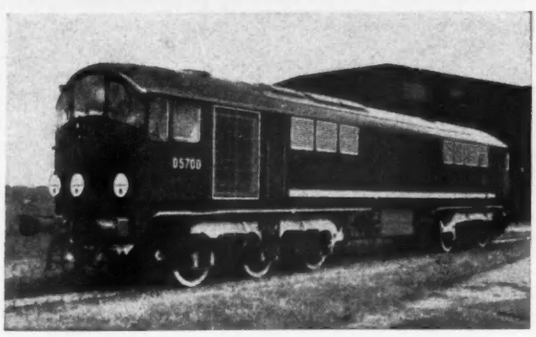

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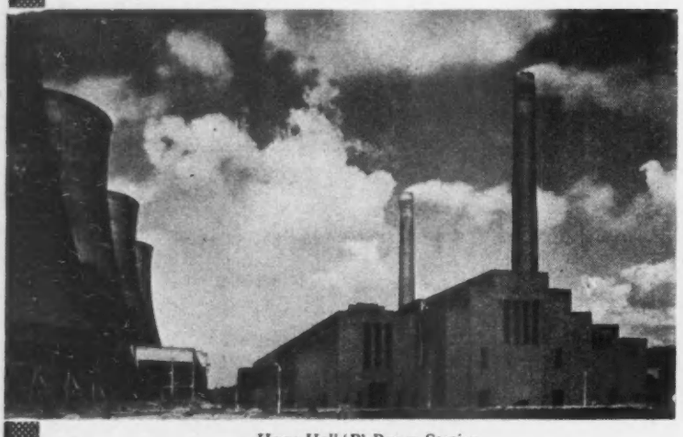
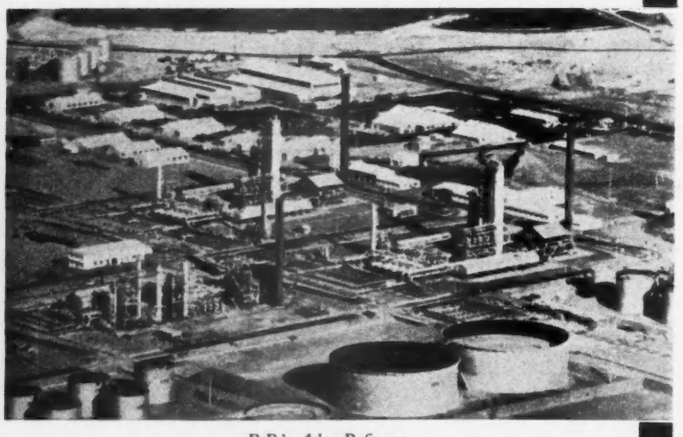


Hams Hall 'B' Power Station.
Photo: Courtesy Central Electricity Generating Board



B.P.'s Aden Refinery.
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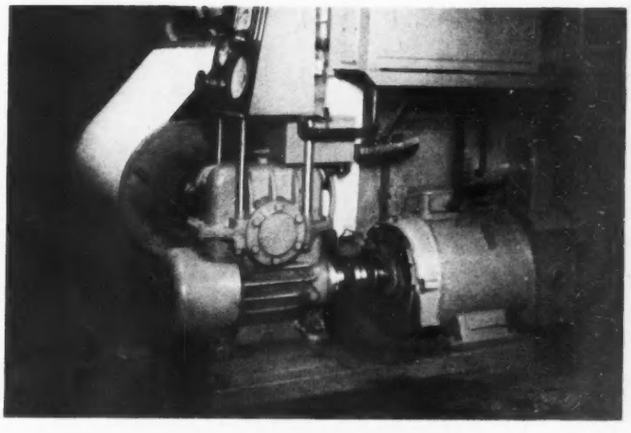

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